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TYPE STUDIES IN THE POLYPORACEAE - 18*

SPECIES DESCRIBED BY G.H. CUNNINGHAM.

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ABSTRACT: Thirty-two species described by G.H. Cunningham in the Polyporaceae have been reviewed and the type specimens examined. The names of 7 species are accepted in the genera in which Cunningham placed them, 9 are treated as synonyms of existing names, and the remainder are considered to belong in other genera. One species is validated with the name *Perenniporia oviforma*. *Australoporus* gen. nov. is described, based on *Polyporus tasmanicus* as type. Fourteen new combinations are proposed: *Inonotus albertinii*, *Rigidoporus aureofulvus*, *Ceriporiopsis coprosmae*, *Phellinus kamahi*, *Fomitopsis maire*, *Oligoporus manuka*, *Schizopora nothofagi*, *Skeletocutis novaezelandiae*, *Ceriporia otakou*, *Antrodiella rata*, *Ischnoderma rosulata*, *Oxyporus spiculifer*, *Australoporus tasmanicus*, and *Ceriporia totara*. In addition, two combinations not directly related to species described by G.H. Cunningham, *Inonotus duostratosus* and *Rigidoporus laetus*, are proposed.

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* Previous paper in series: Ryvarden, L. 1985: Type studies in the Polyporaceae 17. Species described by W.A. Murrill. *Mycotaxon* 23: 169-198.

KEYWORDS: Basidiomycetes, G.H. Cunningham, New Zealand fungi, Polyporaceae.

INTRODUCTION: The New Zealand mycologist G.H. Cunningham (1892-1962) published 15 papers on the polypore fungi, beginning in 1927 and culminating in a book which appeared posthumously (Cunningham, 1965). His book remains the only comprehensive account of the Polyporaceae in Australasia. In all, Cunningham validly published the names of 31 new species. One species was described without a Latin description. He and his colleagues collected mainly in New Zealand, and all but three of his species are based on holotype material collected there.

The herbarium, Plant Diseases Division (PDD) contains all of Cunningham's holotypes and most of his other collections. Isotypes of some species are held at Kew (K).

In this paper, the species are treated in alphabetical order by specific epithet. The basionym is cited for each name and it is followed by the collection data for the holotype. The accepted name for each species is indicated in bold. As well as the holotype, authenticated specimens of each species have been examined where available. Spore measurements were made from material mounted in 3% potassium hydroxide.

Cunningham published all of his species in two New Zealand journals and these are abbreviated as follows:

DSIR Bull.: *New Zealand Department of Scientific and Industrial Research Bulletin.*
PDD Bull.: *Department of Scientific and Industrial Research, Plant Diseases Division Bulletin.*

PORIA AROHA G.H. Cunn. (fig. 1)
PDD Bull. 72: 39 (1947). Holotype: PDD 5254 - New Zealand, Mt Te Aroha, Nov. 1946, G.H. Cunningham, on *Beilschmiedia tawa* (A. Cunn.) Benth. & Hook. f. ex Kirk.

= *Flaviporus aroha* (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 150 (1965).
= *Polyporus tasmanicus* Berk., *Flora Tasmanica* 2: 254 (1860).

= *Fomes tasmanicus* (Berk.) Cooke, *Grevillea* 14: 19 (1885).
  = *Fomitopsis tasmanica* (Berk.) G.H. Cunn., *PDD Bull.* 81: 20 (1949).
  = *Heterobasidion tasmanicum* (Berk.) G.H. Cunn., *DSIR Bull.* 164: 148 (1965).
= *Fomes cuneatus* Lloyd, *Lloyd's Mycol. Writ.* 4, *Syn. Gen. Fomes*: 217 (1915).
  = *Fomitopsis cuneata* (Lloyd) G.H. Cunn., *PDD Bull.* 81: 20 (1949).
= *Polyporus suaderis* Lloyd, *Lloyd's Mycol. Writ.* 5: 859 (1919).

Cunningham (1965) transferred the species to *Flaviporus* Murr., while stating that apart from the presence of 'metuloids' the species could belong in *Heterobasidion* Bref. sensu Cunn. Comparison of the type specimens of *Poria aroha*, *Polyporus tasmanicus* Berk. (K), *Fomes cuneatus* Lloyd (K), and *Polyporus suaderis* Lloyd (K) show that all are conspecific, with *P. tasmanicus* being the oldest name.

Macroscopically, the species varies from resupinate to distinctly pileate. The perennial, narrowly concentrically sulcate and zonate, often ungulate pileus and the pale pink to orange pore surface, when fresh, are diagnostic characters.

In the descriptions of both *H. tasmanicum* and *Flaviporus aroha*, Cunningham (1965) mistakenly reported generative hyphae to be simple septate when, in fact, they have clamps. He also omitted to report that skeletal hyphae are strongly dextrinoid, becoming red-brown in Melzer's reagent. Skeletal hyphae often protrude into the hymenium, and at pore mouths the ends of skeletal hyphae are finely encrusted. The thick-walled metuloids described for *F. aroha* were found to be thin-walled, sometimes collapsed, apically encrusted cystidioles. They are more abundant in fertile specimens and may be scarce or absent in old specimens with a poorly preserved hymenium. Spores are elongate ellipsoid, smooth- and thin-walled, nonamyloid, nondextrinoid, and hyaline in the tubes. Those observed on the pileus surface however are light brown and often larger than those in the tubes. Average spore measurements are 8.5-13 x 3.5-6.5 µm.

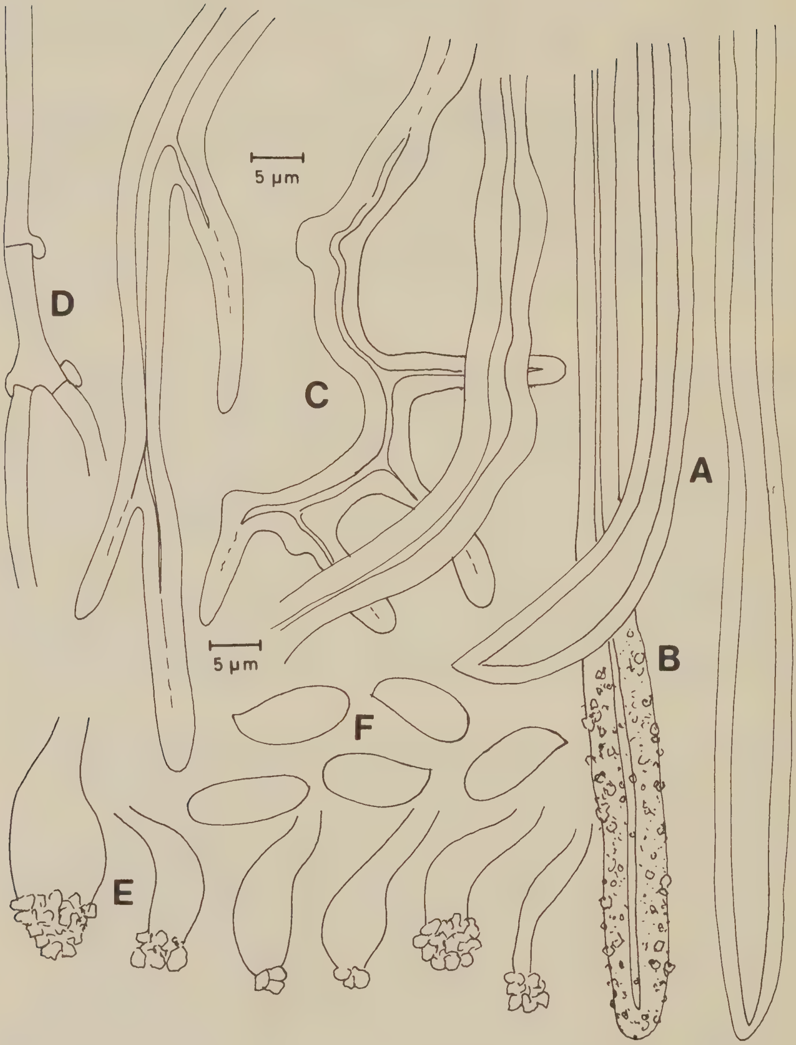


Fig. 1. *Australoporus tasmanicus*. A,C, skeletal hyphae from the context; B, encrusted skeletal hypha from the dissepiments; D, generative hyphae; E, ventricose cystidia from the hymenium; F, spores. From the type of *Poria aroha* (PDD 5254).

The unusual combination of characters found in *P. tasmanicus* means that the species cannot be accommodated in any of the four genera to which Cunningham assigned it. Indeed, we have found no suitable genus for this species.

Dextrinoid skeletal hyphae are found in species of *Perenniporia* Murr., but this genus has distinctly truncate, thick-walled spores with a variable dextrinoid reaction and lacks encrusted skeletal hyphae. *Navisporus* Ryv. is a close relative, having dextrinoid skeletal hyphae and navicular to cylindrical spores of similar size to those in *Polyporus tasmanicus*. However, skeletal hyphae are smooth and no encrusted cystidioles are known in the two species so far described in the genus. Furthermore, the species are brown in colour and have a loose consistency, very different from the hard, light-coloured fruit-bodies of *P. tasmanicus*. *Junghuhnia* Corda is characterised by a dimitic hyphal system of a similar type to that found in *P. tasmanicus*. Cystidia are present, but are developed from the skeletal hyphae and are encrusted at the apex. Thin-walled, ventricose cystidia have not been observed in this genus and the skeletal hyphae are not dextrinoid.

Since this species cannot be accommodated in any known genus without changing the concepts of that genus, we propose a new genus for *P. tasmanicus*.

Australoporus P.K. Buchanan & Ryvarden gen. nov.

Fructificatio resupinata ad pileata, annua ad perennia, pileus sulcatus, umbrosus, zonatus, pori facies alba ad cremea, systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae skeletales dextrinoideae, leviter encrustatae in ore pori, cystidia tenuitunicata, ventricosa ad cylindrica, incrustata, sporae cylindricae, hyalinae, tenuitunicatae, non-amyloidae et non-dextrinoideae.
Type species: **Australoporus tasmanicus** (Berk.) P.K. Buchanan & Ryvarden comb. nov.
Basionym: *Polyporus tasmanicus* Berk., *Flora Tasmanica* 2: 254 (1860).

Fruit-body resupinate to pileate, annual to perennnial, pileus sulcate, brown and zonate, pore surface white to cream to pale orange, tubes concolorous, context light-coloured, hyphal system dimitic, generative hyphae with clamps, skeletal hyphae thick-walled, dextrinoid, in the pore mouths finely encrusted over a considerable length, basidia clavate and 4-sterigmate, cystidia present in the hymenium, hyaline, ventricose to cylindrical, thin-walled, apically encrusted, spores cylindrical, hyaline, smooth, thin-walled, non-amyloid, and non-dextrinoid.

FOMES AWHITU G.H. Cunn.
PDD Bull. 79: 16 (1948). Holotype: PDD 4496 - New Zealand, Auckland, Awhitu Peninsula, Apr. 1946, G.H. Cunningham, on *Beilschmiedia tarairi* (A. Cunn.) Benth. & Hook. f. ex Kirk.

= **Loweporus roseo-albus** (Jungh.) Ryv. & Johans., *A preliminary polypore flora of East Africa*, p. 415 (1980).
= *Phellinus endapalus* (Berk.) G.H. Cunn., *DSIR Bull.* 164: 237 (1965).

COLTRICIA CARTILAGINEA G.H. Cunn. (fig. 2)
DSIR Bull. 164: 262 (1965). Holotype: PDD 3869 - New Zealand, Wellington, Tararua Ranges, Ohau River, Jan. 1933, E.E. Chamberlain, on unknown host.

= **Rigidoporus aureofulvus** (Lloyd) P.K. Buchanan & Ryvarden comb. nov.
Basionym: *Polyporus aureofulvus* Lloyd, *Lloyd's Mycol. Writ.* 7: 1108 (1922).
  = *Coltricia aureofulva* (Lloyd) G.H. Cunn., *PDD Bull.* 77: 9 (1948).

There is a good description of macroscopic characters in Cunningham (1965: 197), but the illustration (fig. 36, p. 197) is simplistic. The spores are smooth, not verruculose as indicated by Cunningham who was probably misled by the asperulate mould spores present in the type specimen. The basidiospores although mostly collapsed and difficult to observe are broadly ellipsoid to subglobose, very thin-walled, 5-6.3 x 4.2-5.5 µm, with a large oil droplet. According to Cunningham's illustration it should be very easy to observe septa on the generative hyphae. However, the context and trama are dominated by strongly agglutinated, thick-walled, skeletal-like hyphae and it took considerable time to find a single clearly differentiated septum.

The holotype, and only collection of *C. cartilaginea*, is a young specimen of *Coltricia aureofulva* (holotype PDD 175; several other PDD collections also examined). In Cunningham (1965: 191) the two species are mainly separated on the mistaken difference in spore wall ornamentation. Spores of *C. aureofulva* are hyaline, smooth, subglobose, nonamyloid, (4.7-)5-6.5(-7.3) x (3.7-)4.5-5.5(-6) µm. Septa of generative hyphae were most readily observed in the trama. Pilei in the holotype of *C. cartilaginea* are smaller than those typical of *C. aureofulva*.

C. aureofulva does not belong in *Coltricia* S.F. Gray, a member of the Hymenochaetaceae, as it does not share the brown hyphal colour nor the black xanthochroic reaction with KOH common to species in the genus. The orange colour, type of consistency, spores, and simple septate generative hyphae indicate that the species belongs in *Rigidoporus* Murr. The distinct reddening of hyphae in KOH reminds one of *Pycnoporellus* Murr. emend. Kotl. & Pouz. but other characters such as pore size, spore shape, and absence of cystidia do not conform to this genus.

Coltricia laeta (Cooke) G.H. Cunn. is closely related to *C. aureofulva* with similar fruit-body colour, red colour of hyphae in KOH, and similar spores. It differs in its larger and more robust form, larger pores, and wider, thinner-

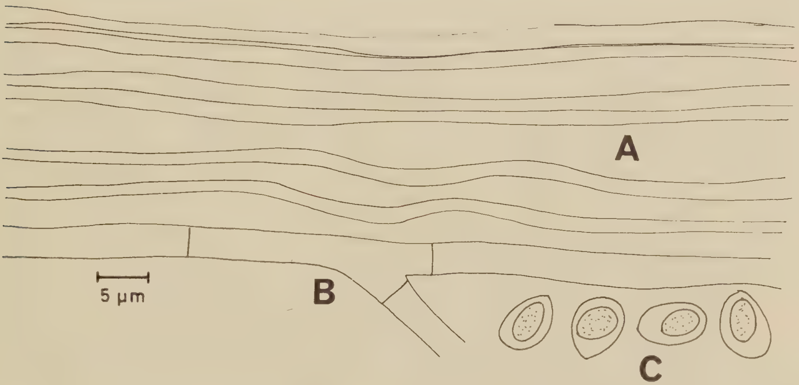


Fig. 2. *Rigidoporus aureofulvus*. A, skeletal-like hyphae from the context; B, simple septate generative hypha; C, spores. From the type of *Coltricia cartilaginea* (PDD 3869).

walled, more frequently simple septate hyphae. As with *C. aureofulva*, we consider that this species belongs in *Rigidoporus*, as:

Rigidoporus laetus (Cooke) P.K. Buchanan & Ryvarden comb. nov.
Basionym: *Polyporus laetus* Cooke, *Grevillea* 12: 16 (1883).

GLOEOPHYLLUM CONCENTRICUM G.H. Cunn. (fig. 3)
DSIR Bull. 164: 263 (1965). Holotype: PDD 12262 - Australia, Queensland, Cape York Peninsula, Lower Archer River, Mar. 1933, L. & G. Thomson, on unknown host.

Accepted as **Gloeophyllum concentricum.**

The colour, irregular hymenophore, trimitic hyphal system, and spore characters of this species conform well to the genus *Gloeophyllum* P. Karst. Although many species in the genus have cystidia, there are some like *G. concentricum* which lack them.

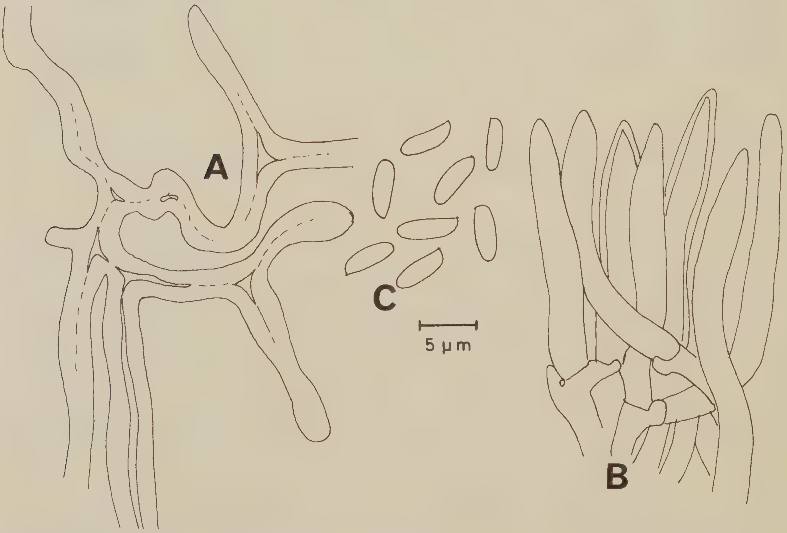


Fig. 3. *Gloeophyllum concentricum.* A, vegetative hyphae from the context; B, sterile hymenium with pointed elements; C, spores. From the type (PDD 12262).

The protologue description is adequate except for the shape and size of spores, described by Cunningham as elliptical, 3-3.5 x 1-1.5 µm. Spores from the type, and only collection of this fungus in herb. PDD, measure 4.2-6 x 1.5-1.8 µm and are better described as cylindrical, straight or weakly curved. The concentric arrangement of lamellae is a highly characteristic feature of this species.

PORIA COPROSMAE G.H. Cunn. (fig. 4)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 38 (1947). Holotype: PDD 5252 - New Zealand, Westland, Lake Mapourika, Nov. 1946, J.M. Dingley, on *Coprosma* sp.

= **Ceriporiopsis coprosmae** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

Cunningham (1965: 130) placed the name in synonymy under *Tyromyces chioneus* (Fr.) P. Karst. However, it is obvious from Cunningham's description that his concept of *T. chioneus* is different from the Friesian concept. Cunningham described spores as 2.5-3.5 x 0.5 µm which agree with our measurements from the type of 2.8-3.3 x 0.4-0.5 µm. This is much smaller than in Fries' species, 3.5-4.5 x 1.5-2 µm (Ryvarden, 1978). Furthermore, the Friesian species is never resupinate.

Cunningham (1947, 1965) described the hyphal system of *C. coprosmae* as dimitic, but careful examination of the thick-walled 'binding' hyphae shows the occasional clamp. The hyphal system is monomitic with walls of generative hyphae varying from thin to irregularly thickened, to very thick or even solid.

Ceriporiopsis Dom. includes species with resupinate, light-coloured fruit-bodies with a monomitic hyphal system and clamps at the septa. No prominent sterile hymenial organs, such as cystidia, are known in the genus, and all species cause a white rot. These characters are found in *C. coprosmae* and we include it in *Ceriporiopsis* as defined in Gilbertson & Ryvarden (1986). Niemelä (1985) has separated species like *Polyporus pannocinctus* Rom. and *Poria subvermispora* Pilát in the genus *Gelatoporia* Niem. because in both these species gelatinized hyphal layers are present in the fruit-body. Such structures or zones are not present in *C. coprosmae*.

Cunningham (1965: 131) stated that his *Tyromyces chioneus* was described by Overholts (1953) as *Polyporus semipileatus* Peck. This is a misunderstanding. *P. semipileatus* is a synonym of *P. niveus* Jungh. and is currently either placed in *Incrustoporia* Dom. or *Skeletocutis* Pouz. because of the characteristically encrusted hyphae, especially in the

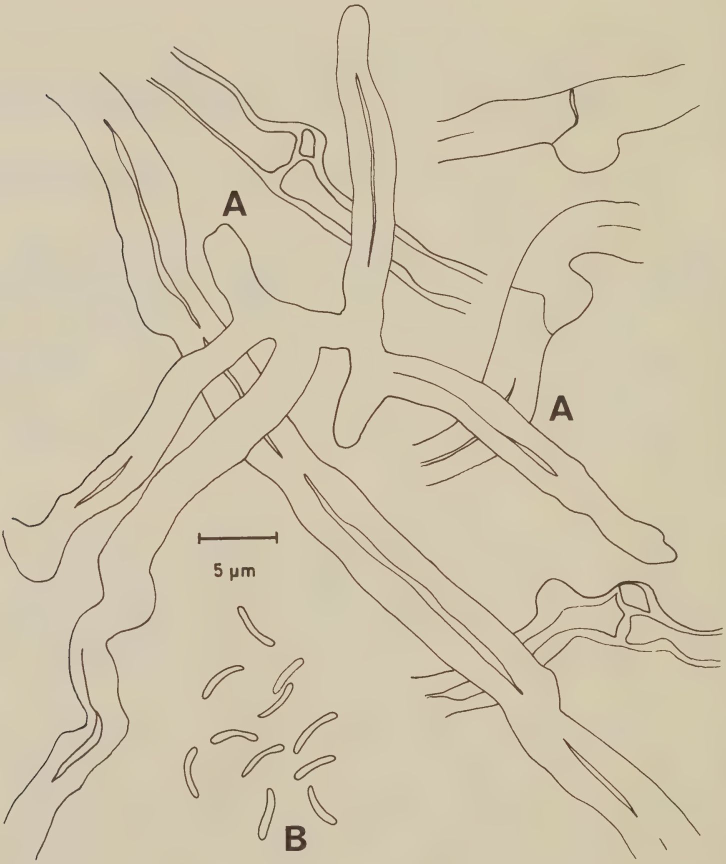


Fig. 4. *Ceriporiopsis coprosmae*. A, generative hyphae with walls varying from slightly and irregularly thickened to more or less solid; B, spores. From the type of *Poria coprosmae* (PDD 5252).

dissepiments. Furthermore, the species is dimitic or semi-trimitic with some branched solid hyphae which have sometimes been described as binding hyphae. Encrusted hyphae of the kind found in *Incrustoporia* are absent in *C. coprosmae*.

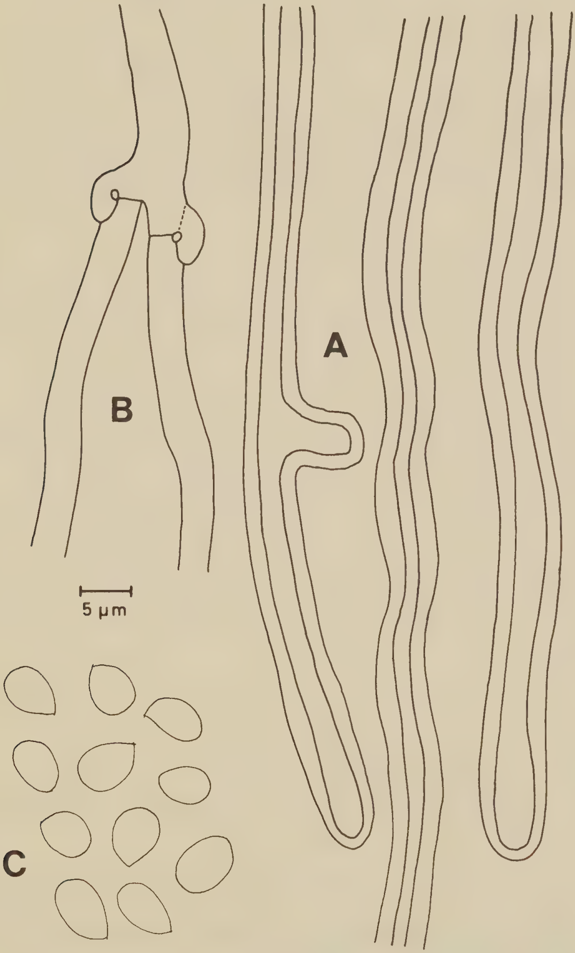


Fig. 5. *Tyromyces falcatus*. A, skeletal hyphae from the context; B, generative hyphae; C, spores. From the type (PDD 15612).

PORIA CORDYLINA G.H. Cunn.
PDD Bull. 72: 39 (1947). Holotype: PDD 5248 - New Zealand, Hamilton, Claudelands Reserve, Nov. 1946, G.H. Cunningham, on *Cordyline australis* Hook. f.

= **Aporpium caryae** (Schw.) Teix. & Rog., *Mycologia* 47: 410 (1955).

TYROMYCES FALCATUS G.H. Cunn. (fig. 5)
DSIR Bull. 164: 262 (1965). Holotype: PDD 15612 - New Zealand, Westland, Ahaura, Orwell Creek, Apr. 1955, J.M. Dingley, on *Nothofagus fusca* (Hook. f.) Oerst.

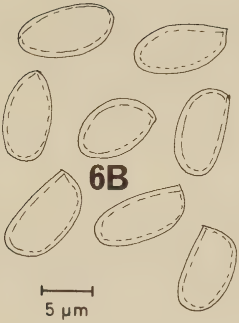
Accepted as **Tyromyces falcatus.**

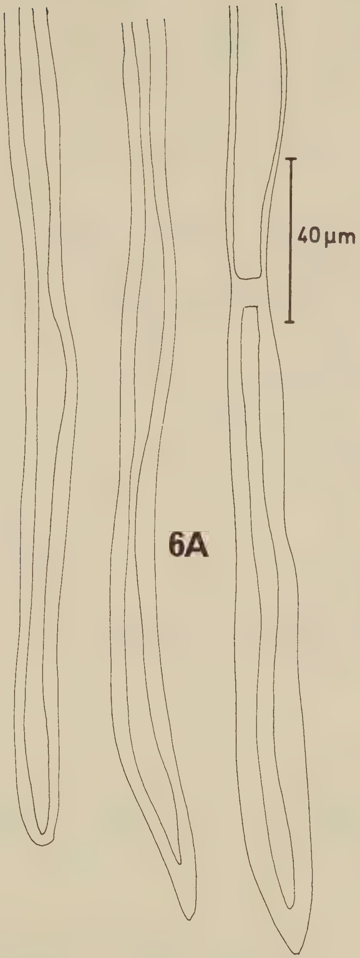
The description by Cunningham of macroscopic characters is satisfactory, but there are misleading statements about the microscopic characters. The septa of the generative hyphae are not simple, but have large, conspicuous clamps. The basidiocarp is composed of mostly unbranched hyphae with very thick walls. These vegetative hyphae were described by Cunningham as binding hyphae but appear in the illustration (Cunningham, 1965: fig. 28) as skeletal hyphae. We interpret them as skeletal hyphae with scattered side-branches, the side-branches not being as common or regular as described by Cunningham. The thick hyphal walls often appear to be multilayered and are refractive in KOH. *T. falcatus* has a harder texture than most other species in *Tyromyces.*

INONOTUS HISPIDANS G.H. Cunn. (fig. 6)
DSIR Bull. 164: 263 (1965). Holotype: PDD 19911 - Australia, Queensland, Magnetic Island, Jun. 1954, J. Hunt, on unknown host.

= **Inonotus albertinii** (Lloyd) P.K. Buchanan & Ryvarden comb. nov.
Basionym: *Polyporus albertinii* Lloyd, *Lloyd's Mycol. Writ.* 3, *Syn. Stip. Stereums*: 160 (1912).

This is the same as *Polyporus albertinii* as indicated by Reid (1967: 164). There is a detailed description in Reid (1963: 277) where he transferred the species to *Phaeolus*





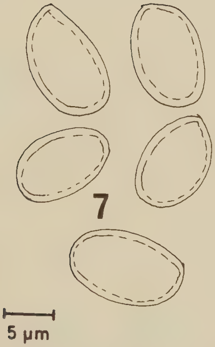


Fig. 6. *Inonotus albertinii*. A, setal hyphae from the trama; B, spores. From the type of *Inonotus hispidans* (PDD 19911).

Fig. 7. *Inonotus duostratosus*. Spores. From the type (BPI).

Pat. That genus is typified by *P. schweinitzii* (Fr.) Pat., and characterised by a brown fruit-body similar to that seen in *Inonotus* species. However, *P. schweinitzii* lacks setae and has instead oil-filled cystidia of a type unknown in the Hymenochaetaceae. Furthermore, it causes a brown rot in the wood, while all members of Hymenochaetaceae give a white rot. We feel that these characters alone are sufficient to exclude *Phaeolus* from the Hymenochaetaceae.

Polyporus albertinii is characterized by setal hyphae of the type seen in many representatives of the Hymenochaetaceae and we are in no doubt that the species belongs in *Inonotus* because of its monomitic hyphal system with wide, brown, simple septate hyphae.

A closely related species is *Polyporus duostratosus* Lloyd from Malaysia (holotype BPI). It is mainly separated from *P. albertinii* by larger pores and spores and clearly belongs in the same genus:

Inonotus duostratosus (Lloyd) P.K. Buchanan & Ryvarden comb. nov. (fig. 7).
Basionym: *Polyporus duostratosus* Lloyd, *Lloyd's Mycol. Writ.* 7: 1317 (1924).

PORIA HUNUA G.H. Cunn.
PDD Bull. 72: 39 (1947). Holotype: PDD 5279 - New Zealand, Auckland, Hunua Ranges, Upper Wairoa Valley, Sep. 1946, J.M. Dingley, on *Beilschmiedia tawa* (A. Cunn.) Benth. & Hook. f. ex Kirk.

= **Antrodiella hunua** (G.H. Cunn.) Ryv. & Johans., *A preliminary polypore flora of East Africa*, p. 257 (1980).

The description of Cunningham (1965: 55) is satisfactory. The species was transferred to *Antrodiella* Ryv. & Johans. by Ryvarden & Johansen (1980) because of the dense basidiocarp, dimitic hyphal system, and small spores.

FUSCOPORIA KAMAHI G.H. Cunn. (fig. 8)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 263 (1965).
Holotype: PDD 5850; isotype PDD 5849 - New Zealand, Bay of Plenty, Mamaku Forest, 9 Nov. 1947, G.H. Cunningham, on *Weinmannia racemosa* Linn. f.

= **Phellinus kamahi** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

This species belongs in *Phellinus* Quél., and is similar in colour and pore size to *P. punctatiformis* (Murr.) Ryv. However, the spores of *P. kamahi* are larger, 5-7(-8.5) x 2.5-3 µm, although Cunningham (1965) described them as being 4-6 x 1.5-2 µm. A conspicuous feature of *P. kamahi* is the coarse crystals encrusting generative hyphae at or near the pore mouths. Cystidioles, present in the hymenium, are hyaline, thin-walled, lageniform and often have elongated, tapering necks.

LARICIFOMES MAIRE G.H. Cunn. (fig. 9)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 262 (1965).
Holotype: PDD 38093 - New Zealand, Auckland, Waitakere Ranges, Anawhata Road, Aug. 1947, J.M. Dingley, on *Nestegis cunninghamii* (Hook. f.) L. Johnson.

= **Fomitopsis maire** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

All collections in PDD are sterile except one (PDD 11098) in which spores are cylindrical, 5-7.5 x 2-2.7 µm. Cunningham (1965) described the spores as ellipsoid, 8-10 x 5-6 µm.

We prefer to place the species in *Fomitopsis* P. Karst. because of the perennial basidiocarp with a crust, slightly coloured context, hyaline, nonamyloid, cylindrical spores, and brown rot in the host. These are all characters of *F. pinicola* (Sw.: Fr.) P. Karst., the type species of *Fomitopsis*.

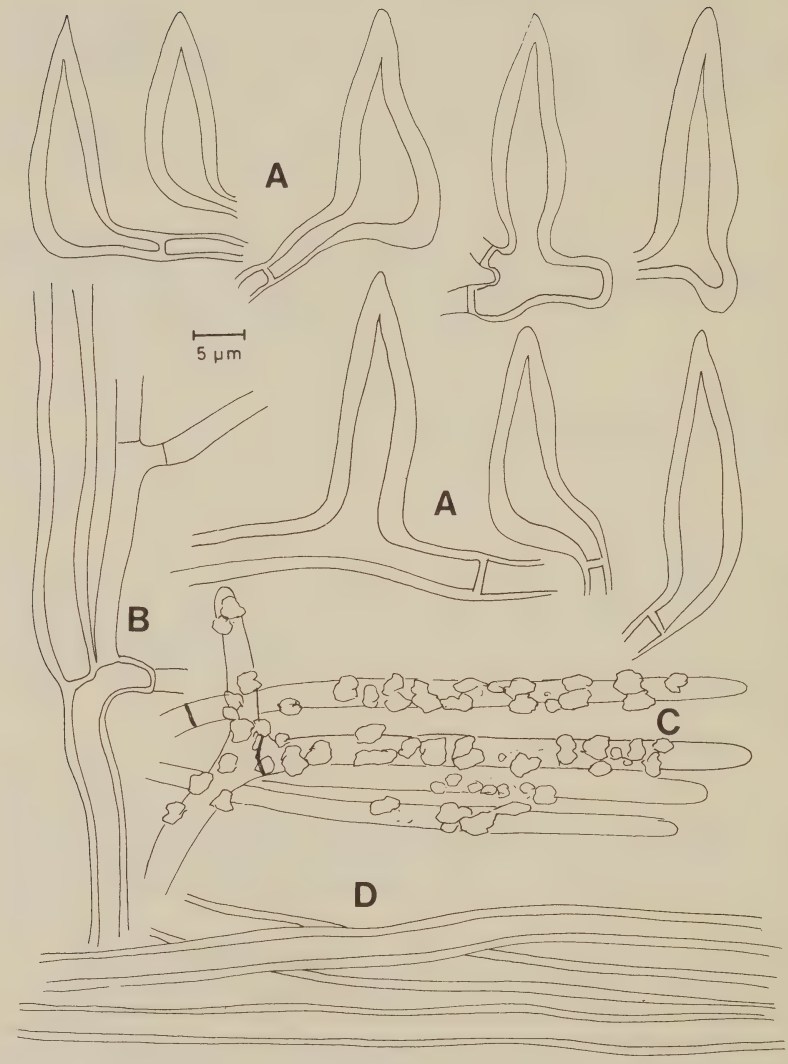


Fig. 8. *Phellinus kamahi*. A, setae; B, generative hyphae with part of skeletal hyphae; C, encrusted hyphae from the dissepiments; D, skeletal hyphae. From the type of *Fuscoporia kamahi* (PDD 5850).

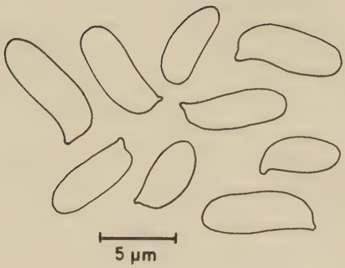


Fig. 9. *Fomitopsis maire*. Spores. From PDD 11098.

PORIA MANUKA G.H. Cunn. (fig. 10)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 38 (1947). Holotype: PDD 4122 - New Zealand, Taupo, Mt Tongariro, Jan. 1940, G.H. Cunningham, on *Leptospermum scoparium* J.R. & G. Forst.

= **Oligoporus manuka** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

This species belongs in *Oligoporus* Bref. because of the resupinate basidiocarp, monomitic hyphal system with clamps at the septa, and the brown rot. Spores of *O. manuka* are cylindrical to allantoid and 6-7.5 x 2-2.5 µm, which is larger than the measurements given by Cunningham (1947, 1965) of 5-6 x 1.5-2 µm.

FUSCOPORIA NOTHOFAGI G.H. Cunn. (fig. 11)
DSIR Bull. 164: 263 (1965). Holotype: PDD 6613; isotype PDD 6614 - New Zealand, Taupo, Mt Ruapehu, Ohakune Track, 12 Dec. 1947, G.B. Rawlings, on *Nothofagus solandri* (Hook. f.) Oerst. var. *cliffortioides* (Hook. f.) Poole.

= **Phellinus nothofagi** (G.H. Cunn.) Ryv., *Norw. J. Bot.* 19: 235 (1972).

The species is characterised by strongly coloured spores, and it is restricted to *Nothofagus*.

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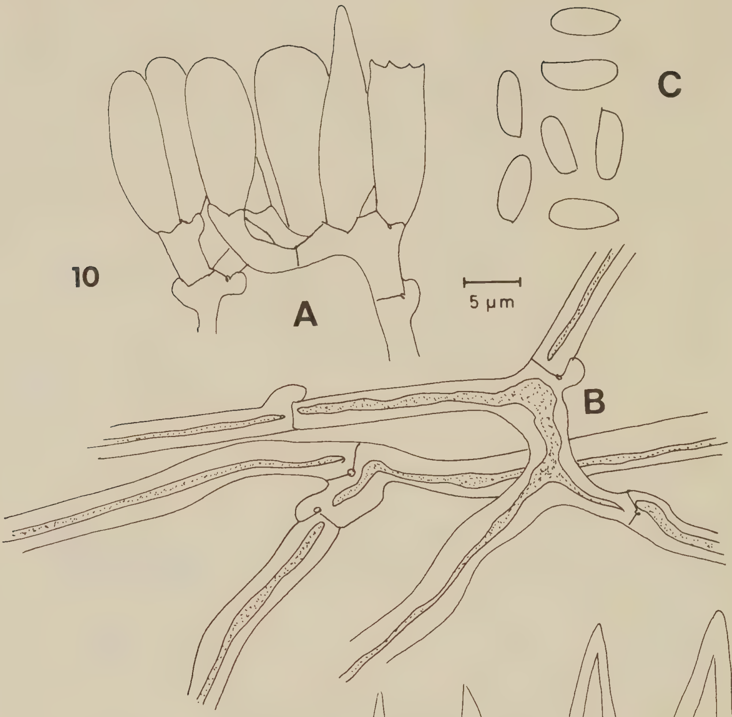

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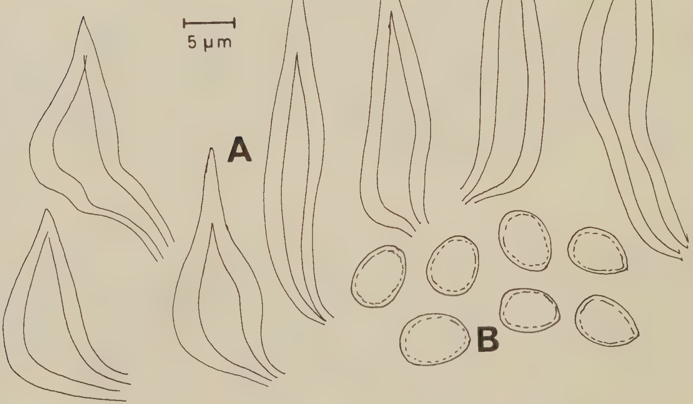

Fig. 10. *Oligoporus manuka*. A, part of hymenium; B, generative hyphae; C, spores. From the type of *Poria manuka* (PDD 4122).

Fig. 11. *Phellinus nothofagi*. A, setae; B, spores. From the type of *Fuscoporia nothofagi* (PDD 6613).

INONOTUS NOTHOFAGI G.H. Cunn. (fig. 12)
DSIR Bull. 78: 1 (1948). Holotype: PDD 5795 - New Zealand, Wellington, Days Bay, Aug. 1947, G.B. Rawlings, on *Nothofagus solandri* (Hook. f.) Oerst.

Accepted as **Inonotus nothofagi.**

As stated by Cunningham (1965), this species is related to *I. radiatus* (Sow.: Fr.) P. Karst. of the Northern Hemisphere, but is easily separated by the coloured spores

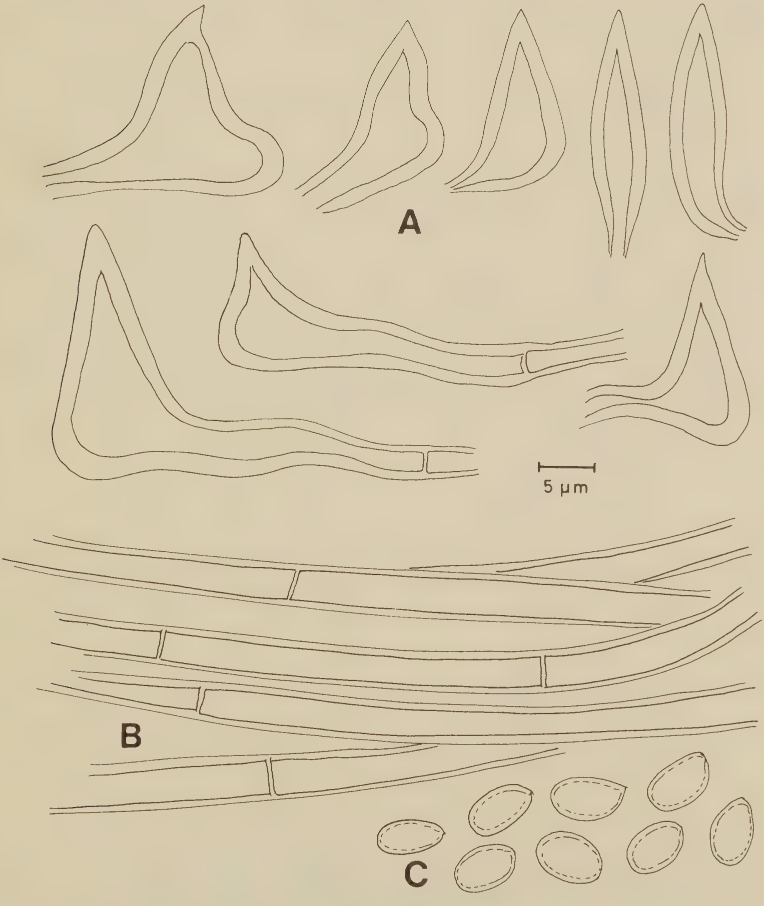

Fig. 12. *Inonotus nothofagi.* A, setae; B, generative hyphae; C, spores. From the type (PDD 5795).

and straight setae. It is confined to *Nothofagus*. Cunningham (1965) included collections on *Quercus* from India under *I. nothofagi* but these were later redetermined as *I. diverticulosepta* Pegler (Pegler, 1967).

PORIA NOTHOFAGI G.H. Cunn. (fig. 13)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 261 (1965). Holotype: PDD 5275 - New Zealand, Taupo, Mt Tongariro, Waihohonu River, Jan. 1947, J.D. Atkinson, on *Nothofagus solandri* (Hook. f.) Oerst. var. *cliffortioides* (Hook. f.) Poole.

= **Schizopora nothofagi** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

This characteristic species belongs in *Schizopora* Velen. emend. Donk and is readily separated from the widespread *S. paradoxa* (Schrad.: Fr.) Donk by its cylindrical to suballantoid spores and distinctly monomitic hyphal system. Otherwise, the two species have in common hyaline cystidioles, bulbous hyphal ends, clamped, *Hyphodontia*-like hyphae, and coarse encrustation of hyphae in the dissepiments. Spores of *S. nothofagi* measure 6-8(-10) x 2-3 µm, which is larger than the measurements given by Cunningham (1965) of 5-6.5 x 1.5-2 µm.

PORIA NOVAEZELANDIAE G.H. Cunn. (fig. 14)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 40 (1947). Holotype: PDD 5322 - New Zealand, Bay of Plenty, Mt Te Aroha, Nov. 1946, G.H. Cunningham, on *Metrosideros* sp.

= **Skeletocutis novaezelandiae** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.
= *Chaetoporus novaezelandiae* (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 71 (1965).

The species was transferred to *Chaetoporus* P. Karst. by Cunningham (1965) because he interpreted the encrusted skeletal hyphae as true cystidia. We concur with Rajchenberg (1983: 505), however that the skeletal hyphae do not form true cystidia. The finely encrusted hyphae are of the type characteristic of the genus *Skeletocutis* Kotl.

& Pouz. Other characters of *S. novaezelandiae*, such as the dimitic hyphal system with clamped generative hyphae, small pores, and small, nonamyloid spores, are also typical of *Skeletocutis*.

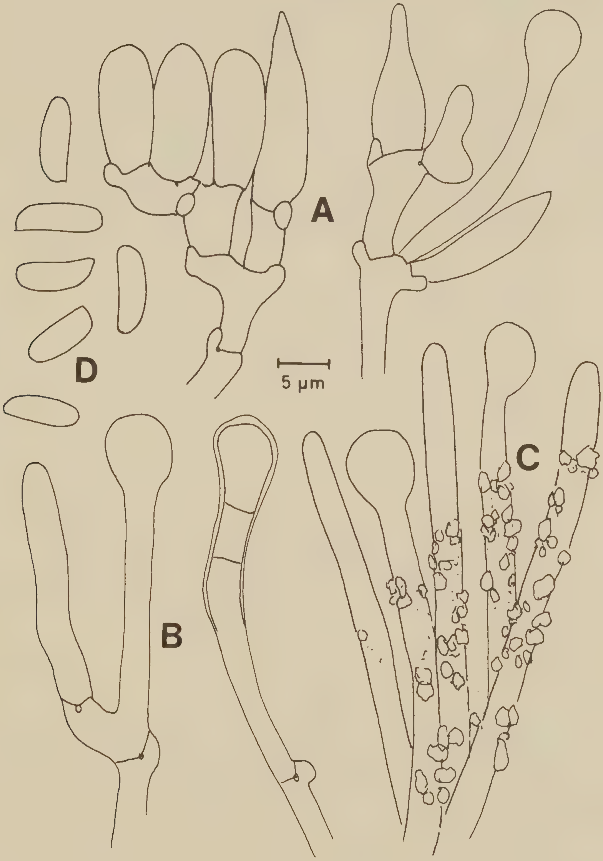

Fig. 13. *Schizopora nothofagi*. A, basidial clusters with cystidioles; B, bulbous hyphae; C, encrusted hyphae from the dissepiments; D, spores. From the type of *Poria nothofagi* (PDD 5275).

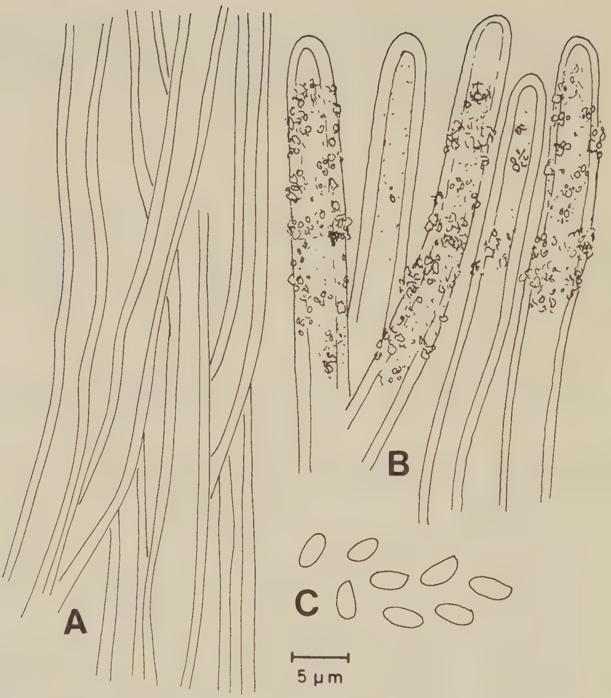

Fig. 14. *Skeletocutis novaezelandiae*. A, skeletal hyphae; B, encrusted skeletal hyphae from the dissepiments; C, spores. From the type of *Poria novaezelandiae* (PDD 5322).

PORIA OTAKOU G.H. Cunn. (fig. 15)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 38 (1947). Holotype: PDD 4182 - New Zealand, Otago Lakes, Kinloch, Jan. 1942, G.H. Cunningham, on *Nothofagus fusca* (Hook. f.) Oerst.

= **Ceriporia otakou** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

The species belongs in *Ceriporia* Donk because of the resupinate basidiocarp, monomitic hyphal system with simple septate hyphae, absence of cystidia, and smooth, thin-walled, nonamyloid spores, 3.5-5 x 2-3 µm.

PORIA OVIFORMA G.H. Cunn. not validly published; no Latin description.
PDD Bull. 72: 35 (1947).

This species has a variable fruit-body that can be resupinate, effused-reflexed, or distinctly pileate. Cunningham (1947) first placed the species in *Poria* Pers., but later, to include the pileate habit, he recombined the name in *Polyporus* Mich.: Fr. (Cunningham, 1948a) and then in *Tyromyces* (Cunningham, 1965).

Contrary to the statement of Cunningham (1965), the spores of this species are dextrinoid. The species belongs in *Perenniporia* Murr. because of this reaction, the thick-walled, ovoid, truncate spores, and the dimitic hyphal system. It is related to *P. medulla-panis* (Jacq.: Fr.) Donk, but is readily separated by the distinctly dextrinoid

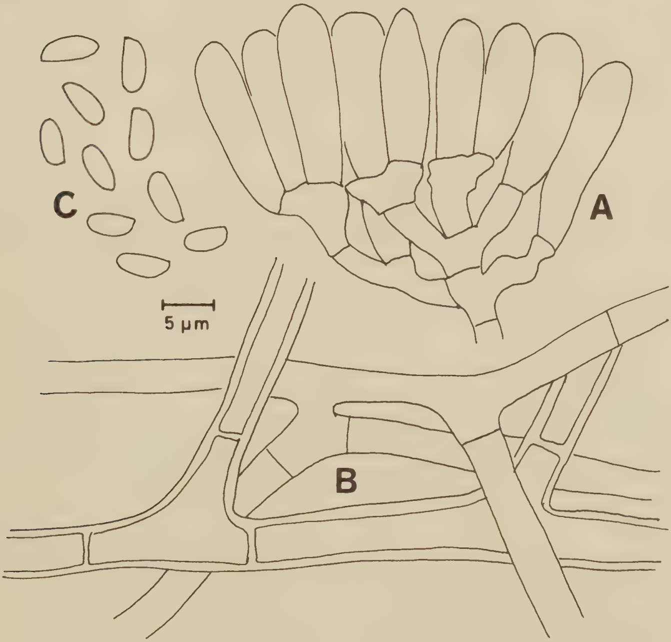

Fig. 15. *Ceriporia otakou*. A, part of hymenium; B, generative hyphae; C, spores. From the type of *Poria otakou* (PDD 4182).

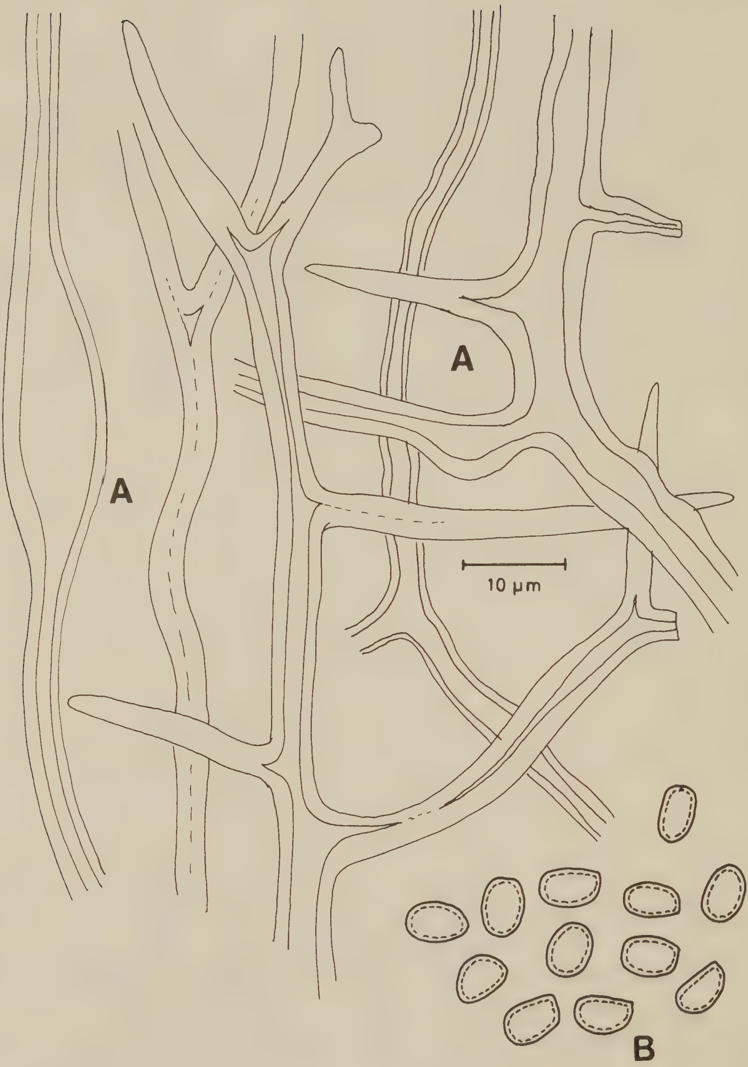

Fig. 16. *Perenniporia oviforma*. A, skeletal hyphae; B, spores. From the type of *Poria oviforma* (PDD 4435).

spores, measuring 5-7 x 3.5-5.5 µm, and the much more frequently branched vegetative hyphae. Some hyphae are so branched that they can be characterised as binding hyphae of the Bovista type. However, there are transitions to more narrow, slightly flexuous and solid vegetative hyphae of the type common in *P. medulla-panis*.

The following name is proposed:

Perenniporia oviforma G.H. Cunningham ex P.K. Buchanan & Ryvarden sp. nov. (fig. 16).

Fructificatio resupinata ad pileata, annua ad interdum biennia, pars reflexa angusta, alba vel ochracea, poria facies cremea vel ochracea, pori rotundi vel angulati, 4-5 per mm. System hypharum dimiticum, hyphae generatoriae hyalinae, fibulatae, hyphae vegetativae crassitunicatae, indextrinoideae, interdum ramosae ad instar hypharum ligantium, sporae ovoideae, truncatae, crassitunicatae, laeves, hyalinae, dextrinoideae, 5-7 x 3.5-5.5 µm.
Typus: New Zealand, Auckland, Swanson, Waitakere Ranges, 18 Nov. 1945, J.M. Dingley, on *Neopanax arboreum* (PDD 4435).

PORIA PIRONGIA G.H. Cunn.
PDD Bull. 72: 39 (1947). Holotype: PDD 4406 - New Zealand, Waikato, Mt Pirongia, 28 Dec. 1945, J.M. Dingley, on *Hedycarya arborea* J.R. & G. Forst.

= **Pachykytospora papyracea** (Schw.) Ryv., *Norw. J. Bot.* 19: 233 (1972).

As reported by Cunningham (1965) under *Poria papyracea* (Schw.) Cooke, this is the same as *Pachykytospora papyracea* although the hyphae are somewhat more branched in the New Zealand specimens than in specimens from North America.

PORIA RATA G.H. Cunn.
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 72: 40 (1947). Holotype: PDD 3868 - New Zealand, Rangitikei, Ruahine Ranges, Ngatimoti (?), 27 Jan. 1933, J.G. Gibbs, on *Metrosideros robusta* A. Cunn.

= **Antrodiella rata** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

This is a species of *Antrodiella* Ryv. & Johans. because of the dense basidiocarp, dimitic hyphal system, small spores, and minute pores with a resinous appearance. It is separated from other species in the genus by the black lines between successive strata of the tubes and by the thickness of the basidiocarp (to 2.5 cm thick). In some collections, scattered, dark-brown, granular deposits are present on walls of the skeletal hyphae. The spores are slightly larger and the pores smaller than those of *A. semisupina* (Berk. & Curt.) Ryv., the type species.

POLYPORUS ROSULARIS G.H. Cunn.
PDD Bull. 74: 36 (1948). Holotype: PDD 3914 - New Zealand, Gisborne, Lake Waikaremoana, Waikareiti Track, Jan. 1933, J.G. Gibbs, on *Nothofagus* sp.

= **Grifola rosularis** (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 90 (1965).

Cunningham (1965: 90) provided a good description of the species and transferred it to *Grifola* S.F. Gray because fruit-bodies usually consist of a cluster of imbricate pilei joined by a tuberous base. *G. frondosa* (Fr.) S.F. Gray, the type species, is similar to *G. rosularis* in having the same type of hyphal system and spores, although both spores and pores of *G. frondosa* are larger.

G. rosularis could be considered to belong in *Tyromyces*, which includes many species with imbricate basidiocarps, a monomitic hyphal system, and subglobose to ellipsoid, nonamyloid, nondextrinoid spores; *T. pubescens* (Fr.) Pilát is a representative example of this group. However, almost all *Tyromyces* species produce applanate basidiocarps on dead wood rather than semistipitate basidiocarps arising from a common base. Thus we maintain the species in *Grifola*.

POLYPORUS ROSULATUS G.H. Cunn. (fig. 17)
Dept. Sci. Industr. Res., Pl. Dis. Div. Bull. 74: 36 (1948). Holotype: PDD 5691 - New Zealand, Taupo, Kaingaroa State Forest, May 1946, G.B. Rawlings, on *Pinus radiata* D. Don.

= **Ischnoderma rosulata** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.
= *Grifola rosulata* (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 93 (1965).

Cunningham (1965) placed this species in *Grifola* because of the numerous pilei arising from a common base. However, this species has a brown to blackish, very thin cuticle at the pileus surface, sometimes covered in part by a brown adpressed tomentum. Hyphae of the tomentum are brown, wide, and thick-walled with large, conspicuous clamps; hyphae of the context are similar but paler coloured or more typically hyaline. In these characters the species is similar to *Ischnoderma resinosum* (Fr.) P. Karst. Spores of *I. rosulata* are ellipsoid and are smaller than the cylindrical spores of *I. resinosum*. We consider that *Ischnoderma* P. Karst. is a more suitable genus than *Grifola*.

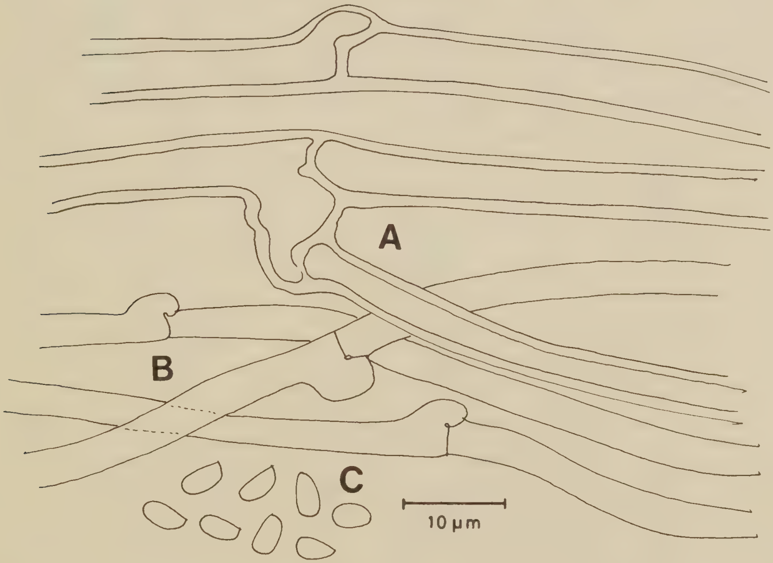

Fig. 17. *Ischnoderma rosulata*. A, generative hyphae from the context; B, generative hyphae from the trama; C, spores. From the type of *Polyporus rosulatus* (PDD 5691).

IRPEX SPICULIFER G.H. Cunn. (fig. 18)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 261 (1965).
Holotype: PDD 19144 - New Zealand, Buller, vic. Reefton, Staircase Creek, 29 Nov. 1952, S.D. Baker, on *Nothofagus fusca* (Hook. f.) Oerst.

= **Oxyporus spiculifer** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

Cunningham described this species in *Irpex* Fr. mainly because the pore mouths in mature specimens are partly split. However, this macroscopic feature is now considered to be of minor importance in delimiting genera. Many genera, such as *Antrodia* P. Karst., *Trametes* Fr., and *Spongipellis* Pat., include some species with a regular pore surface and others with a more or less dentate one. *Irpex* is typified by *I. lacteus* Fr. (see Maas Geesteranus, 1974), a distinctly hydnoid species with a dimitic hyphal system. The generative hyphae are simple septate and the cystidia develop from protruding skeletal hyphae which are encrusted over a considerable length. The cystidia in *O. spiculifer* are typically ventricose and apically encrusted, although some hyphae in the dissepiments are encrusted over longer segments. The cystidia and monomitic hyphal system of *O. spiculifer* indicate that it does not belong in *Irpex*.

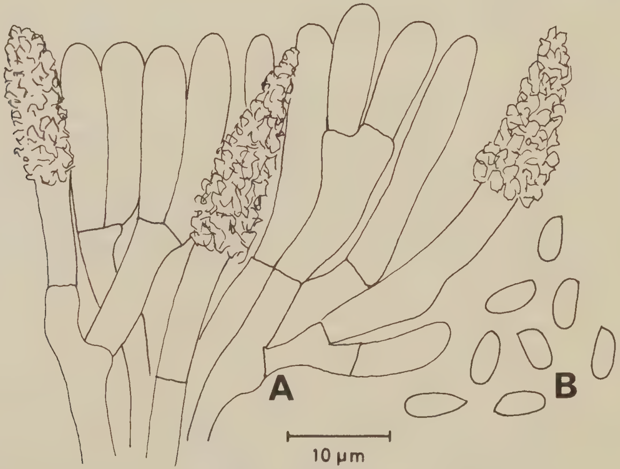

Fig. 18. *Oxyporus spiculifer*. A, part of the hymenium with cystidia; B, spores. From the type of *Irpex spiculifer* (PDD 19144).

Oxyporus Donk is characterised by a monomitic hyphal system with simple septate generative hyphae and mostly apically encrusted cystidia. *O. pellicula* (Jungh.) Ryv. from tropical Africa and Asia is similar in many respects to *O. spiculifer*, with a dentate, lacerate pore surface, but its spores are larger and more broadly ellipsoid. Spores of *O. spiculifer* measure 5-6.5 x 2.5-3 μm, larger than the dimensions given by Cunningham (1965) of 4-5 x 1.5-2 μm. From herbarium material, the type of rot appears to be white.

TYROMYCES STRAMENTICUS G.H. Cunn. (fig. 19)
DSIR Bull. 164: 262 (1965). Holotype: PDD 11038 - New Zealand, Taupo, Mt Ruapehu, Whakapapaiti Stream, Jan. 1951, J.M. Dingley, on *Nothofagus solandri* (Hook. f.) Oerst. var. *cliffortioides* (Hook. f.) Poole.

Accepted as **Tyromyces stramenticus.**

A good description is given in the protologue. Characteristic features of the species include the coarse bundles of agglutinated hyphae covering the pileus surface, the agglutinated hyphae of both context and dissepiments, lacerate pore mouths, and the small spores measuring 2.5-4 x 2-2.5 μm. The hyphal system is monomitic with the clamped generative hyphae only readily separable at the margin.

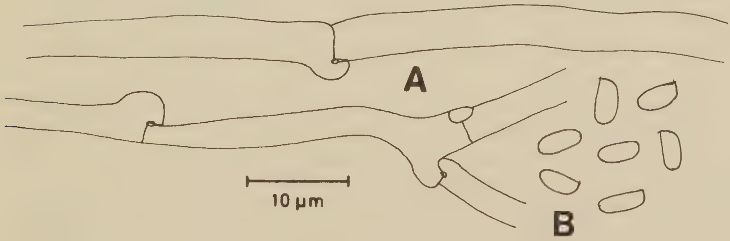

Fig. 19. *Tyromyces stramenticus.* A, generative hyphae; B, spores. From the type (PDD 11038).

COLTRICIA STRIGOSA G.H. Cunn.
PDD Bull. 77: 4 (1948). Holotype: PDD 4417 - New Zealand, Coromandel, Little Barrier Island, 3 Oct. 1945, J.M. Dingley, on rich humus on ground under *Leptospermum.*

Accepted as **Coltricia strigosa.**

This is a highly characteristic species in *Coltricia* with small, strigose basidiocarps and subglobose spores of variable size, measuring 4.5-7 x 4-6 µm. In Melzer's reagent, spores show a negative reaction, unlike those of some other *Coltricia* species which are weakly dextrinoid.

TRAMETES TAWA G.H. Cunn. (fig. 20)
PDD Bull. 80: 9 (1948). Holotype: PDD 4822 - New Zealand, Southland, Woodlaw State Forest, Nov. 1946, G.B. Rawlings, on unknown host.

   = *Metuloidea tawa* (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 250 (1965).
= **Junghuhnia rhinocephalus** (Berk.) Ryv., *Mycotaxon* 20: 353 (1984).
   = *Trichaptum rhinocephalum* (Berk.) G.H. Cunn., *DSIR Bull.* 164: 102 (1965).

Junghuhnia rhinocephalus, a rather widespread species in Australia and New Zealand, is somewhat deviating in the genus *Junghuhnia* Corda since vegetative hyphae are light brown and the context is ochraceous to dark cinnamon. Most other species in the genus have hyaline hyphae and a white, ochraceous to yellowish context, although the context of *J. collabens* (Fr.) Ryv. is cocoa-brown. This variation in context and hyphal colour is accepted within the genus.

Cunningham (1965) described both *Trichaptum rhinocephalum* and *Trametes tawa* and considered them to be distinct species. He examined only the type collection of *J. rhinocephalus*, from Kew, and four small fragments apparently from this collection were retained (PDD 28062). Examination of these fragments reveals a mixed collection. Three fragments, which are sterile, correspond to *J. rhinocephalus*, while a fourth is of a different polypore species with a white context, hyaline hyphae, simple septate generative hyphae and subglobose spores, 5-5.5 x 4.5-5.5 µm. These characters appear in Cunningham's description of *Trichaptum rhinocephalum*, indicating that he mistakenly based at least part of his description on the discordant element. *J. rhinocephalus* should have been described with a brown context, light brown vegetative hyphae, clamped generative hyphae, and ellipsoid spores measuring 3.5-4 x 2-2.5 μm.

A more accurate description of *J. rhinocephalus* was given by Cunningham (1965) for *Metuloidea tawa*, which he designated the type species of *Metuloidea* G.H. Cunn. This genus, mainly characterised by brown vegetative hyphae and encrusted cystidia, becomes a synonym of *Junghuhnia*.

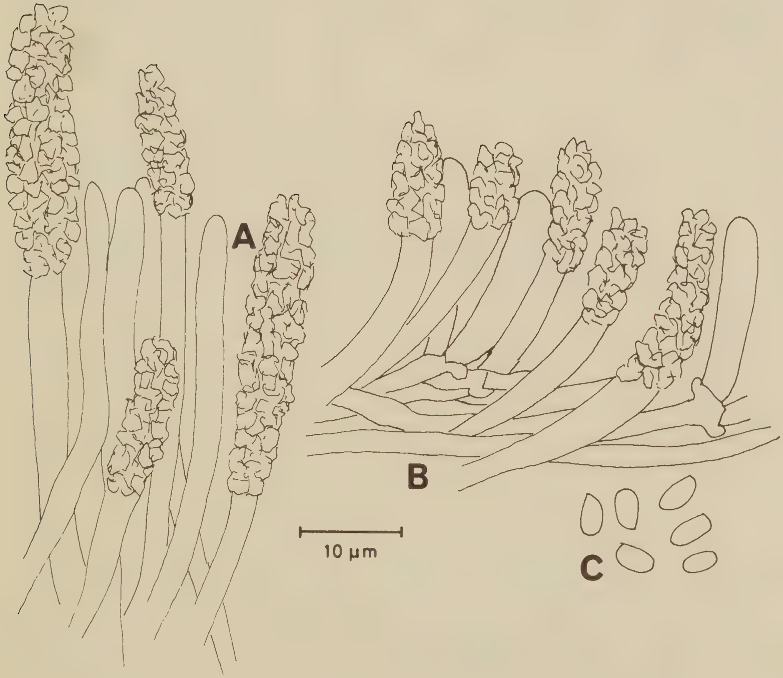

Fig. 20. *Junghuhnia rhinocephalus*. A, hyphae and cystidia from the dissepiments; B, sterile hymenium with cystidia. From the type (K). C, spores. From the type of *Trametes tawa* (PDD 4822).

FUSCOPORIA TAWHAI G.H. Cunn. (fig. 21)
PDD Bull. 73: 8 (1948). Holotype: PDD 5509 - New Zealand, Taupo, Mt Tongariro, headwaters of Pangarara River, Dec. 1946, G.H. Cunningham, on *Nothofagus solandri* (Hook. f.) Oerst. var. *cliffortioides* (Hook. f.) Poole.

= **Phellinus tawhai** (G.H. Cunn.) G.H. Cunn., *DSIR Bull.* 164: 229 (1965).

There is a good description in Cunningham (1965: 229). The hyaline, cylindrical spores from the type specimen measure 7-8.5 x 2-2.5 µm, somewhat larger than the dimensions given by Cunningham (1965). As noted by Cunningham, *Phellinus ferreus* (Pers.) Bourd. & Galz. is closely related but differs in being always adnate, never effused-reflexed nor with a black pileus surface as in pileate forms of *P. tawhai*.

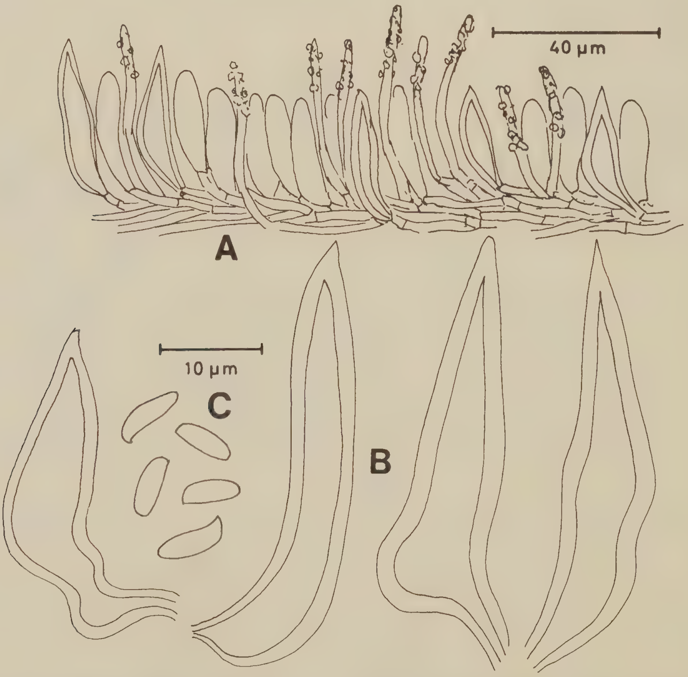

Fig. 21. *Phellinus tawhai*. A, section through the hymenium with setae and projecting encrusted hyphae; B, setae; C, spores. From the type of *Fuscoporia tawhai* (PDD 5509).

TYROMYCES TOATOA G.H. Cunn.
DSIR Bull. 164: 262 (1965). Holotype: PDD 7792 - New Zealand, Taupo, Mt Ruapehu, Whakapapa Stream, 19 Oct. 1949, J.M. Dingley, on *Phyllocladus alpinus* Hook. f.

Accepted as **Tyromyces toatoa.**

The dark surface and thin cuticle of the small, effused-reflexed pilei make the species easy to recognise and separate it from other species in the genus. Spores are suballantoid, 4-5 x 1.5-2 µm.

PORIA TOTARA G.H. Cunn. (fig. 22)
New Zealand Dept. Sci. Industr. Res. Bull. 164: 261 (1965). Holotype: PDD 6657 - New Zealand, Coromandel, Whitianga - Coromandel Road, Nov. 1947, G. Chamberlain, on *Podocarpus totara* G. Benn. ex D. Don.

= **Ceriporia totara** (G.H. Cunn.) P.K. Buchanan & Ryvarden comb. nov.

The description in Cunningham (1965) is accurate except he described the hyphal system as dimitic with clamped generative hyphae and binding hyphae. We found it to be dimitic with simple septate generative hyphae, 1.5-2.5 µm diam., with a thin to slightly thickened wall, and hyaline, thick-walled to solid, sparingly branched skeletal hyphae, 2-3.5 µm diam. Spores are oval to subglobose, apiculate, hyaline, and nonamyloid, measuring 2.5-3 x 1.7-2.5 µm. The cream to yellow pores are highly variable in appearance, from labyrinthine and up to 3 mm long, to more regular, angular, and 3-5(-7) per mm.

The species cannot be maintained in *Poria* because *Poria* Adanson is a nomen ambiguum and *Poria* Pers. a later homonym (Ryvarden, 1985). However, it is difficult to find a suitable genus for the species. Arguments can be made for different genera depending on the character(s) considered to be most important. If we consider that septation of the generative hyphae is important taxonomically at the generic level, then genera such as *Rigidoporus* Murr., *Ceriporia* Donk, and *Physisporinus* P. Karst. are possible alternatives.

Rigidoporus has a monomitic to pseudo-dimitic hyphal system, globose spores, small papillate cystidioles in the hymenium and, in some species, large encrusted cystidia. The type species and some related species are pileate and have a reddish pore surface when fresh, fading when dry. The pores are regular and small. The irregular pores, the yellowish to cream pore surface and lack of sterile hymenial elements are characters that separate *Poria totara* from *Rigidoporus* species. The skeletal hyphae of *P. totara* are also more densely arranged and narrower than hyphae typical of *Rigidoporus* where the rather wide, thick-walled, non-septate hyphae can be interpreted as either skeletal hyphae or as strongly sclerified generative hyphae with very rare septa.

Ceriporia includes resupinate, soft to hard, fragile species with a pore surface varying from white, cream, yellowish or reddish. Sterile hymenial organs are lacking and most species have cylindrical to oblong-ellipsoid spores. However, it has a monomitic hyphal system without a trace of thick-walled hyphae of any kind.

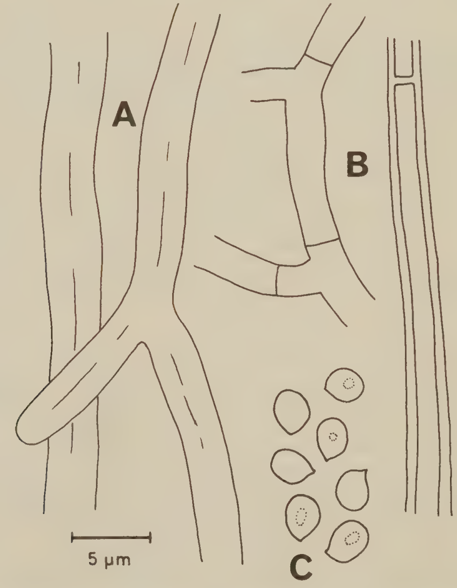

Fig. 22. *Ceriporia totara*. A, skeletal hyphae, sparingly branched; B, simple septate generative hyphae; C, spores. From the type of *Poria totara* (PDD 6657).

Physisporinus includes two resupinate species with large, globose spores. All hyphae are thin-walled and wide, and cystidial elements are lacking. The colour of the pore surface varies from whitish to red or black when dry and the pores are regular.

Septation of generative hyphae is commonly assumed to be very important in the Polyporaceae and very few genera include species with both types of septation. However, if we ignore the simple septa in *Poria totara*, other characters such as the type of fruit-body, the pores, colour, and dimitic hyphal system with dominance of skeletal hyphae suggest *Diplomitoporus* Dom. The spores of that genus are cylindrical to ellipsoid, while those of *P. totara* are subglobose. *Diplomitoporus* species cause a white rot as does *P. totara*, while species of *Antrodia* P. Karst., another candidate genus, all cause a brown rot.

Thus, whatever genus is considered, the inclusion of *P. totara* introduces a discordant element. Rather than create a new genus for this species, we feel it is more satisfactory to include it in an existing genus where only one new character is introduced. The choice then is between *Ceriporia* and *Diplomitoporus*. As we currently consider that septation is more important than the type of hyphal system, which recently has been shown to be complex with intergrading types, we conclude that *Ceriporia* is the best choice. *C. xylostromatioides* (Berk.) Ryv. has subglobose spores and a rather irregular hymenophore and is probably the most closely related species to *P. totara*. The main character separating these two species is the skeletal hyphae of the latter.

FOMES UNCATUS G.H. Cunn.
PDD Bull. 79: 3 (1948). Lectotype: PDD 5776 - New Zealand, Auckland, Riverhead, May 1947, G.B. Rawlings, on *Dysoxylum spectabile* (Forst. f.) Hook. f.

= **Phellinus wahlbergii** (Fr.) Reid, *Contr. Bolus Herb.* 7: 97 (1975).

Phellinus wahlbergii is characterised by hooked setae and subglobose, hyaline spores, 4-5.5 x 3.5-5 µm. Cunningham (1965: 222) mistakenly included *F. uncatus* as a synonym of *Phellinus setulosus* (Lloyd) Imaz. but the latter is tropical, typically ungulate, and has large, ventricose, straight setae and larger spores. Australasian specimens included by Cunningham under *P. setulosus* and *P. zealandicus* (Cooke) G.H. Cunn. are considered to be conspecific with *P. wahlbergii*.

A single type collection for *F. uncatus* was not designated by Cunningham (1948b). Two collections, PDD 5776 and PDD 5777, have the same data as given in the protologue for the type, except for the date, May 1947 vs June 1947. An error in citation of the date in the protologue is suggested. PDD 5776 is herein designated the lectotype of *F. uncatus*; this specimen has a majority of setae with hooked apices whereas setae in PDD 5777 are mostly straight.

Cunningham (1948b, 1965) described the rot caused by this fungus as brown but as with all species of *Phellinus* the rot is white.

DENDROCHAETE VALLATA G.H. Cunn.
DSIR Bull. 164: 261 (1965). Holotype: PDD 19906 - Australia, northern Queensland, Stony Creek, Jan. 1954, W. Pont (no. 4334), on ground ? (probably growing from buried wood).

= **Laetiporus percicinus** (Berk. & Curt.) Gilbn., *Mycotaxon* 12: 385 (1981).

The type is a typical specimen of *Laetiporus percicinus*. The species is widespread in the tropics, although nowhere common. It was first recorded from Australia by Reid (1963: 289) as *Meripilus talpae* (Cooke) Reid. The specimen at Kew that Reid examined (W. Pont no. 4334) has the same collection data as the type of *D. vallata*.

PORIA WERAROENSIS G.H. Cunn.
PDD Bull. 72: 40 (1947). Holotype: PDD 1838 - New Zealand, Wellington, Weraroa, 12 Aug. 1919, G.H. Cunningham, on *Coprosma grandifolia* Hook. f.

Accepted as **'Poria' weraroensis.**

The holotype is badly eaten by insects, discoloured, and sterile. Only one other collection is known. This collection (PDD 50957), in agreement with Cunningham's description of *P. weraroensis*, has discrete and coalescing, circular, resupinate colonies, individually 5-15 mm across and 1 mm thick, coloured pale yellow with a white margin. Pores are large, 1-2 per mm, with the hymenium lining the floor of the shallow tubes and extending up the vertical tube walls. The dimitic hyphal system consists of clamped generative hyphae and hyaline to pale yellow, nondextrinoid skeletal hyphae. Spores are hyaline, ellipsoid, 3.5-5 x 2.5-3 µm.

Both the type and PDD 50957 appear to be young and not fully developed. The irregular hymenophore varying from almost smooth through tuberculate to dentate or poroid in the centre of the small fruit-bodies strongly resembles species of *Schizopora*. However, the sterile elements typical of this genus are lacking in the fertile collection (PDD 50957), although the spores and the hyphal system come very close to that of *S. paradoxa* (Schrad.: Fr.) Donk, a widespread and variable species. The protruding skeletal hyphae in the dissepiments of *S. paradoxa* have a characteristic scattered, rather coarse encrustation. Some hyphae in *P. weraroensis* are encrusted, but they differ in appearance from those seen in *Schizopora*. The hymenium in young specimens of *Schizopora* often covers both the pore base and the side walls, underlining the relationship of this genus to many smooth and grandinioid species in the Corticiaceae.

The dimitic hyphal system and fertile pore bases suggest that *P. weraroensis* might belong in *Theleporus* Fr. but the species lacks the dendrohyphidia and the more regular pore surface seen in even young and small fruit-bodies of *Theleporus*.

More collections are needed before a proper evaluation of this species can be made.

ACKNOWLEDGEMENTS:
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MYCOTAXON

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TOMENTELLAGO GEN. NOV.
(THELEPHORACEAE, BASIDIOMYCETES)

by
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SUMMARY

Tomentellago gen. nov. is characterized by a resupinate, bluish-green, poroid basidiome with brown, ornamented basidiospores and a presence of thelephoric acid. This clearly places the genus in the Thelephoraceae of which the genus is the second poroid representative. Tomentellago aeruginascens sp. nov. from Colombia is described as the type species.

While collecting in Colombia in 1978, one of us (L.R.) collected a conspicuous, bluish, resupinate polypore. The colour was reminiscent of that found in the corticioid genera Lazulinospora (Burdsall & Larsen 1974) and Byssocorticium (Eriksson & Ryvarden 1976) which, however, have more or less smooth basidiocarps.

A microscopical examination of the Colombian polypore revealed ornamented brown spores which immediately raised the suspicion that the species belonged in the Thelephoraceae Chev., which is characterized by such spores.

Byssocorticium is characterized by smooth, thick-walled and cyanophilous spores, while Lazulinospora has finely ornamented hyaline spores, which are blue in 2 % KOH (Burdsall & Setliff 1974). Because the spores were hyaline and finely warted, both Larsen (1968) and Burdsall & Larsen (1974) concluded that Lazulinospora should be placed in Corticiaceae and suggested that Trechispora probably was the closest relative. The spores of the new species from Colombia also change colour in 2% KOH due to a pH shift, thus indicating a relationship to Lazulinospora.

The Thelephoraceae is characterized by variably shaped basidiocarps sharing ornamented brown spores, and thelephoric acid is present in most of the investigated species (Arpin & Fiasson 1971, Besl et al., 1975, Bresinsky & Rennschneid 1971).

To check the presence of thelephoric acid in the new species from Colombia, a small piece of the basidiocarp was extracted with pyridine. Also basidiocarps of Hydnellum suaveolens

(Scop.:Fr.) Karst., Boletopsis subsquamosa (Fr.) Kotl. & Pouz., and Thelephora palmata Scop.:Fr. were tested in the same way. The pyridine solution was then added a drop of concentrated ammonia. If thelephoric acid or analogous compounds are present, the solution will turn bright blue, and this was the case with all four species.
Thus, because of the thelephoric acid or very closely related compounds and the ornamented, pale brown spores, it was concluded that the species was best placed in the Thelephoraceae.

In the Thelephoraceae, Boletopsis has been the only poroid repre-sentative (see Pegler 1973). Boletopsis is characterized by a stipitate fruitbody with pale brown, somewhat angular spores and is probably mycorrhizal (see Gilbertson & Ryvarden 1986).
The new species from Colombia is resupinate, has large angular pores and is saphrophytic on dead wood. Its spores are distinctly tuberculate and not angular. In conclusion, it does not seem reasonable to place the new species in Boletopsis based on the presence of a poroid hymenophore and thelephoric acid when there are so many other divergent characters.

TOMENTELLAGO AERUGINASCENS gen. nov. et spec. nov.
Hjortst. & Ryv.

Fructificatio resupinata, adnata, mollis, plus minus aeruginosa; pori angulatis, irregularibus, circiter 0.25- mm latis. Systema hyphale monomiticum, hyphae sine fibulis, hyalinae vel plerumque viridescentes (KOH). Cystidia nulla. Basidia plus minus clavata, sinuosa, frequenter constricta et leviter pedunculata, 20-30 x 5-6 um, 4 sterigmatibus; Sporis subglobosis vel ellipsoidiis, verrucosis, in KOH hyalinis vel flavidae-dilute infuscatis, post demum caeruleis, 4.5-5.5 x 6-7 vel circuter 5.5 um diametro.
Holotypus: Colombia. Magdalena, Parque Nacional Tayrona, Estacion Canaveral, 0-30 m.a.s.l. June 14, 1978. L. Ryvarden No. 15911 (O). Isotypus: In Hjm. priv. herb. and col.
Fruitbody resupinate, adnate, soft, bluish-green when fresh, in the herbarium almost verdigris green but still with a somewhat bluish margin. Pores angular, irregular, 0.25-1 mm wide and 1-2 mm deep, uniform in colour or with the pore surface more pale. Hyphal system monomitic, hyphae thin- to moderately thick-walled, 3-4(-5) um wide, without clamps, hyaline or in KOH pale green after 1-5 minutes, most hyphae turn bluish in KOH and in Melzer's reagent.
Cystidia absent.
Basidia more or less sinuose, frequently constricted and slightly stalked, 20-30 x 5-6 um, with 4 sterigmata, but some basidia seen with only two sterigmata, with a clampless base.
Basidiospores verrucose, subglobose to ellipsoid, either about 5.5 um across or 4.5-5.5 x 6-7 um, thick-walled, more or less hyaline to pale yellow brown in H_2O, becoming bluish in both KOH and Melzer's reagent, yellowish brown in cotton blue.

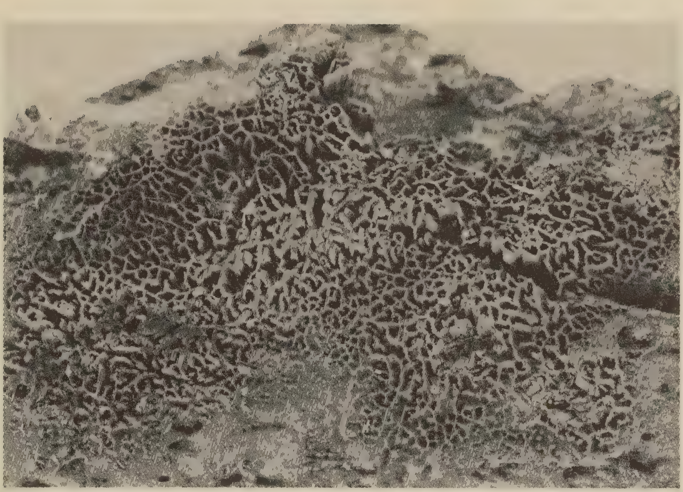

Fig. 1. Tomentellago aeruginascens, the holotype, ca. 2 x nat. size.

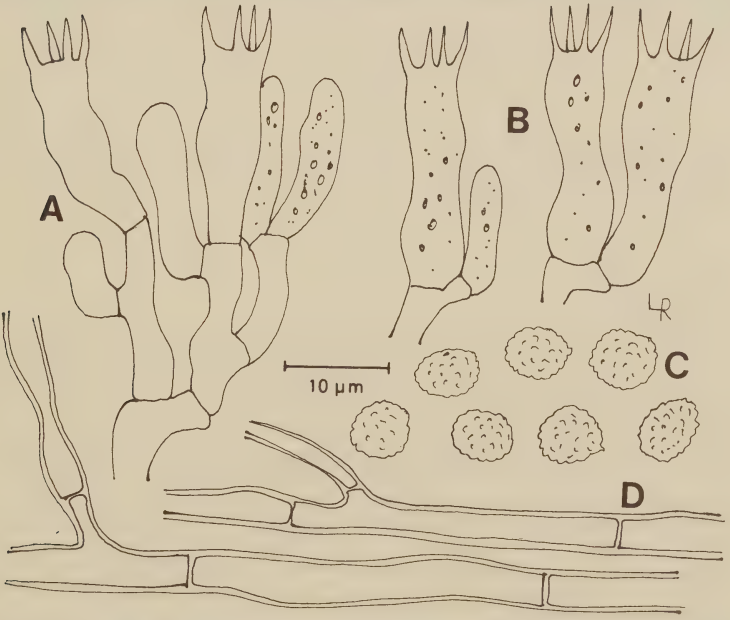

Fig. 2. Tomentellago aeruginascens A) Part of hymenium, B) Basidia, C) Spores, D) Hyphae from the subiculum. From the holotypus.

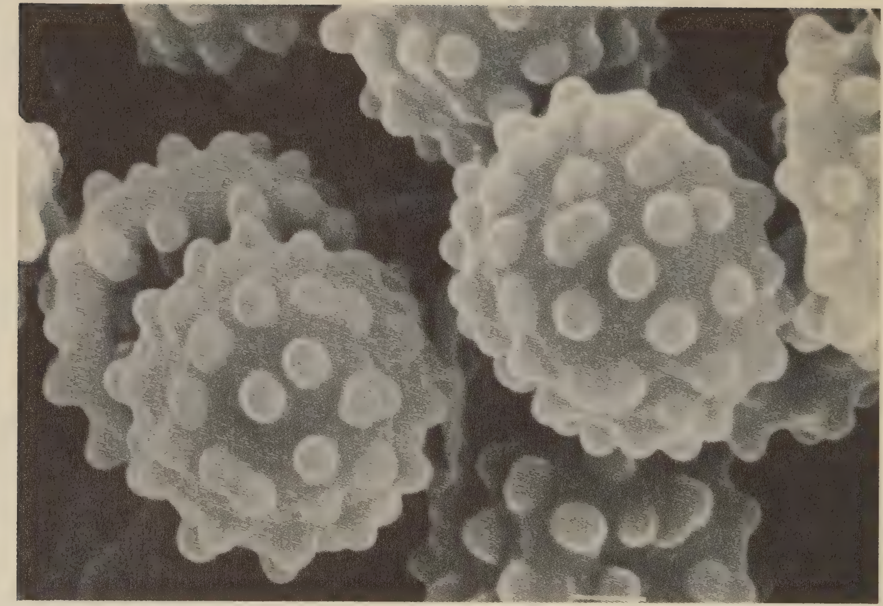

Fig. 3. Tomentellago aeruginascens, spores. Scale = 1 µm.

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MYCOTAXON

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TYPE STUDIES IN THE POLYPORACEAE 19

SPECIES DESCRIBED BY M.C. COOKE

by

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SUMMARY

Of the 142 polypores described by M.C. Cooke, 36 are accepted, 86 are taxonomic synonyms, 5 names are invalid, 10 are of uncertain status because of sterile and badly developed types while the type specimens were not found for 5 species. The following new combinations are proposed: **Albatrellus cochleariformis** (Cke) Ryv., **Antrodia porothelioides** (Cke) Ryv., **Coriolopsis burchellii** (Cke) Ryv., **Datronia brunneo-leuca** (Berk.) Ryv., **Leucophellinus hobsonii** (Cke) Ryv. and **Rigidoporus incurvus** (Cke) Ryv.

M.C. Cooke took over as a curator of the mycological collection in Kew Gardens after J.M. Berkeley. He apparently soon sorted out a number of polypores left by Berkeley with notes and preliminary names. As is evident from the following list, far too many of these names were published by Cooke. Many of the type specimens are in bad condition and represent forms of already described species. Cooke, like so many of his contemporary mycologists never collected themselves in the tropics. Thus, they never gained the necessary field knowledge so important to understand the morphological variation in a species.

All types of Cookes polypores are deposited in the herbarium of Royal Botanic Gardens, Kew (K), so this information is not repeated for each species.

The species are placed alphabetically according to specific epithet and the place of publication is in almost all cases cited as G and two digits indicating Grevillea, volume and page respectively. In the very few cases where Cooke did not publish in Grevillea, a full reference is given.

The type locality is indicated in all cases where it is known. When a species is accepted taxonomically, it is cited in the appropriate genus with a reference to a recent description, or the species is described if no modern description exists.

acuta, Tram. Cke. G. 10:132, 1882, Richmond River (Australia).
= **Coriolopsis floccosa** (Jungh.) Ryv.

adelphica, Tram. Cke. G. 19:103, 1891, Madagascar
= **Hexagonia hirta** (Fr.) Fr.

aethiops, Pol. Cke. G. 9:99, 1881. Kala Nuddi (India).
= **Phellinus** sp. sterile

alabamae, Pol. Berk. & Cke. G. 6:130, 1878, Alabama, USA.
= **Pachykytospora alabamae** (Berk. & Cke.) Ryv. For a description, see Ryvarden & Johansen 1980:461.

albo-cincta, Poria Cke. & Massee
= **Porogramme albo-cincta** (Cke. & Massee) Lowe. For a description, see Ryvarden & Johansen 1980:48.

alutacea, Lenz. Cke. G. 10:121, 1882, Japan.
= **Lenzites acuta** Berk. as indicated by Bresadola on the sheet.

anax, Pol. Berk. ex Cke. G. 12:37, 1883. Ohio, USA.
= **Bondarzewia montana** (Quel.) Sing.

andamani, Daed. Berk. ex Cke. G. 19:93, 1891
= **Earliella scabrosa** (Pers.) Gilbn. & Ryv.

antrachopilus, Pol. Cke. G. 12:16, 1883. S.W. Australia
= **Tyromyces campylata** (Berk.) Ryv. as already indicated by Cunningham (1965:92).

arenosus, Pol. Cke. G. 13:2, 1884, Malaya.
= **Coriolopsis asper** (Jungh.) Teng.

argentatus, Pol. Cke. G. 15:20, 1886. Victoria, Australia.
= **Trametes cingulata** Berk.

argillaceus, Pol. Cke. G. 7:1, 1878. California, USA.
= **Aporpium caryae** (Schw.) Teix. & Rog.

astrostrigosus, Pol. Cke. G. 20:2, 1890, New Zealand.
= **Tyromyces astrostrigosus** (Cke.) Cunn. For a description see Cunningham 1965:120.

atrovinosa, Poria Cke. G. 10:131, 1882. Clarence River, Australia.
= **Phellinus** sp., the type is sterile.

auricoma, Poria Lév. ex Cke. G. 15:26, 1886. Marqusas.
= **Ceriporia mellea** (Berk.) Ryv.

badius, Fomes Berk. ex. Cke. G. 15:21, 1886. Arctic America.
= **Phellinus badius** (Berk. ex Cke.) Cunningh.
Without being aware of it, Cooke validated Berkley's illegitimate name **Polyporus badius** of 1843 (non **P. badius** Schw. 1823.) The type locality is certainly not correct, more probably the specimen came from Australia.

beaumontii, Pol. Cke. G. 15:26, 1886. Alabama, USA.
= **Antrodia** sp. sterile and without reaction in Melzer's reagent. Its identity is unknown.

bifasciatus, Lenz. Cke. G. 21:37, 1892. Victoria, Australia.
= **Gloeophyllum striatum** (Fr.) Murr.

binnendykei, Pol. Kurz. ex Cke. G. 15:19, 1886. Java.
= The type has not been found.

bireflexus, Pol. Cke. G. 10:101, 1882. Queensland, Australia.

= **Trametes** sp. cfr. **marianna** (Pers.) Ryv. The type is sterile and almost glabrous. Cunningham 1965:167, stated it to be **T. zonata** (Nees:Fr.) Pil., but in this species the pileus is tomentose to almost hirsute. No specimen of this boreal species has been seen from Australia.

breviporus, Pol. Cke G. 12:17, 1883. Endeavour River, Australia.
= **Phellinus gilvus** (Schw.) Pat.

burchellii, Tram. Berk. ex Cke. G. 19:102, 1891.
= **Coriolopsis burchelli** (Cke.) Ryv. comb. nov. Basionym: **Trametes burchellii** Cke. Grevillea 19:102, 1891.
Basidiocarp pileate, annual, up to 3 cm wide, 1 cm thick at the base, and apparently elongated and shelflike, type 3 cm long, tough and flexible, upper surface dark brown, finely tomentose at the margin, towards the base matted and finely scrupose to warted, azonate, margin sharp and bent downwards, pore surface dark brown, pores thin-walled and angular, 0.8-1.5 mm wide, tubes concolorous, up to 1 cm deep, , white on the inside walls, context dark brown, up to 2 mm depp, homogeneous.
Hyphal system trimitic, generative hyphae with clamps, 2-4 µm wide, skeletal hyphae dominating, 3-8 µm wide, thick-walled and pale brown, binding hypahe present in context, tortuous and richly branched, 2-4 µm wide, pale golden brown. Basidia and spores not seen.
This is a conspicuous species because of the snuff brown basidiocarp and the large angular, thin-walled pores. I have found no prior name for the taxon and no recent description that could cover this taxon. It is placed in **Coriolopsis** because of the trimitic hyphal system and the coloured skeletal hyphae.

caesio-glaucus, Pol. Cke. G. 10:121, 1882. Japan.
= **Trametes versicolor** (L.:Fr.) Pil. as already indicated on the sheet by Imazeki.

carneo-niger, Pol. Cke. G. 12:15, 1883. Daintree River, Australia. = **Microporus affinis** (Fr.:Blume & Nees) Kunt.

carteri, Poria Cke. G. 15:25, 1886. India.
= **Phellinus carteri** (Cke.) Ryv. For a description, see Ryvarden & Johansen 1980:147.

caryophylleus, Fomes Cke. G. 15:21, 1886. Brazil.
= **Phellinus caryophylleus** (Cke.) Ryv. For a description, see Ryvarden & Johansen 1980:147.

caryophylleus, Polystictus Cke G. 15:22, 1886. Venezuela.
= **Microporellus obovatus** (Jungh.) Ryv.

cervicornis, Pol. Cke. G. 17:59, 1889. St. Lucia.
= **Antrodiella versicutis** (Berk. & Curt.) Ryv. The type is deeply split and represents an abarrent form.

cinncinati, Poria Cke. G. 15:27, 1886. Ohio, USA.
= **Irpex lacteus** Fr. Indicated already by Bresadola on the sheet.

cochleariformis, Pol. Cke. G. 14:12, 1885. Perak, Malaysia.
= **Albatrellus cochleariformis** (Cke.) Ryv. comb. nov.
Basionym: **Polyporus cochleariformis** Cke. Grevillea 14:12, 1885.
Basidiocarp annual, laterally stipitate, pileus semicircular, entire to deeply lobed or incised, up to 6 cm from stipe attach- ment to margin, probably fleshy when fresh, rigid and fragile when dry and apparently shrunken by drying, up to 3 mm thick, no special taste in dry condition.
Upper surface dark brown to almost black in parts, glabrous, dull and densely wrinkled when dry and with a very thin cuticle of adpressed hyphae, stipe concolorous, up to 3 mm in diameter, very dense and homogeneous, pore surface dark brown, partly decurrent on stipe, pores invisible to the naked eye, pore surface shiny when turned in the light, tubes dense, cartilaginous and dark brown, up to 2 mm deep, context paler than tubes, brown and fibrous, up to 1 mm deep.
Hyphal system monomitic, generative hyphae with simple septa, in the context strongly inflated, up to 35 µm wide with a wall thickness of up to 3 mm, straight to branched in right angles, in the stipe partly with straight, very thick-walled hyphae, up to 25 µm wide, mixed with frequently branched hyphae, all hyphae strongly agglutinated, in the trama richly branched and more difficult to tear apart, cystidia and basidia not observed, spores globose, thin-walled, hyaline and IKI-, 4-4.5 µm in diameter. No substrate indicated.
The species seems clearly to belong in **Albatrellus** because of the large inflated hyphae which characterize the genus and indicate that it is more related to **Agaricales** in a wide sense, than to the true polypores. The monomitic hyphal system and the round spores together with a fleshy, stipitate fruitbody are also features shared with other species in **Albatrellus.**
Albatrellus dispansus (Lloyd) Canf. & Gilbn. has similar spores, but has a basidiocarp with several pilei of a yellow colour and much larger pores (2-3 per mm). It is known from Japan and is connected to coniferous forests.

The colour, the tiny pores and the very wide, straight hyphae with scarce simple septa, characterize **A. cochleriformis.** Fresh collections are desirable to establish its colour in fresh condition.

concavus, Fomes Cke. G. 20:44, 1890. Queensland, Australia.
= **Fomitopsis concava** (Cke.) Cunn. There is a good description in Cunningham (1965:189).

concentricus, Pol. Cke. G. 9:13, 1880. Unknown type-locality.
= **Ganoderma applanatum** (Pers.) Pat.

contrarius, Fomes Cke. G. 15:21, 1886. Cuba.
= **Perenniporia contraria** (Cke.) Ryv. For a description, see Ryvarden and Johansen (1980:464).

corrugatus, Gloeoporus Cke. G. 19:105, 1886. India
= **Antrodiella** sp. sterile and badly contaminated, and its identity is unknown. Macroscopically it reminds of **A. liebmannii** (Fr.) Ryv. but the skeletal hyphae are more tortuous than seen in this species. The name should be dropped as a nomen ambiguum.

cornubovis, Pol. Cke. G. 13:2, 1884. Perak, Malaysia.
= **Nigrofomes melanodermus** (Mont.) Murr.

cristata, Tram. Cke. G. 10:132, 1882. North Australia.
= **Coriolopsis telfarii** (Kl.) Ryv.

cupreo-vinosus, Polyst. Cke. G. 15:23, 1886. Panuré, Brasil.
= **Trametes cupreo-roseus** (Berk.) Lloyd.

curreyanus, Pol. Cke. G. 15:20, 1886.
= **Bjerkandera adusta** (Fr.) Karst. Cunningham (1965:50) describes it as a species of its own, but the type is sterile and fresh specimens of the taxon described by Cunningham should be examined to find a proper generic place for this species. It may be that **Bjerkandera** is a proper genus if it really is different from **B. adusta.**

curreyii, Fomes Cke. G. 15:21, 1886. nomen novum for **Polyporus xerophyllaceus** Currey, non Berkeley.
= **Coriolopsis asper** (Jungh.) Ryv.

dictyoporus, Pol. Cke. G. 12:17, 1883. Queensland, Australia.
= **Macrohyporia dictyopora** (Cke). Ryv. For a description see Cunningham (1965:68).

dickinsii, Tram. Cke. G. 19:100, 1891. Japan.
= **Daedalea incana** (Lév.) Ryv.

ecklonii, Polyst. Cke. G. 15:23, 1886. South Africa.
= **Coriolopsis floccosa** (Jungh.) Ryv.

emericii, Pol. Cke. G. 10:96, 1882. Queensland, Australia.
= **Polyporus grammocephalus** Berk.

favoloides, Hexagonia Cke. G. 14:118, 1886. New Guinea.

= **Lenzites vespacea** (Pers.) Ryv.

fergussonii, Polyst. Cke. G. 15:23, 1886. Natal, South Africa.
= **Coriolopsis asper** (Jungh.) Ryv.

flabellum, Daed. Cke. G. 19:93, 1891. Rangoon, Burma.
= **Lenzites acuta** Berk.

flavipora, Poria Cke. G. 15:25, 1886.
= **Schizopora flavipora** (Cke) Ryv. For a description, see Ryvarden & Johansen (1980:553, as **S. trichiliae**) or David & Rajchenberg (1985:314 as **S. carneo-lutea**).

fumosogriseus, Pol. Cke. & Ellis G. 9:103, 1881. Pennsylvania, USA.
= **Bjerkandera adusta** (Fr.) Karst.

fuscomarginata, Poria Berk. & Cke. G. 15:24, 1886. Rhode Island, USA.
= **Perenniporia subacida** (Peck.) Donk as already indicated by Lowe (1966:109).

gallogrisea, Poria Cke. G. 15:25, 1886. India.
= **Antrodia** sp. sterile. Unknown identity.

gausapata, Tram. Cke. G. 19:102, 1891. USA.
= The type has not been found.

geogena, Poria Cke. G. 15:25, 1886. Venezuela.
= **Antrodia** sp. The type is sterile and badly contaminated.

geotropus, Pol. Cke. G. 13:32, 1884. Demarara, Brazil.
= **Rigidoporus ulmarius** (Fr.) Imaz.

gerardi, Polyst. Berk. & Cke. G. 15:24, 1886. Amazonas, Brazil.
= **Polyporus** s.str. The type is sterile.

glaucotus, Pol. Cke. G. 9:12, 1880. Japan.
= **Phellinus adamantinus** (Berk.) Ryv. as indicated already by Bresadola on the sheet.

glutinifer, Pol. Cke. G. 15:19, 1886. Mauritius.
= **Polyporus udus** Jungh. as indicated by J. Wright on the sheet.

guilfoylei, Lenz. Cke. G. 10:64, 1881. Queensland, Australia.
= **Lenzites acuta** Berk.

hartmannii, Pol. Cke. G. 12:14, 1883. Queensland, Australia.
= Accepted in the genus, see Cunningham 1965:79 for a description.
There are 5 collections on the sheet. Coll. Toivooma, Queensland (ink, Cooke's hand) is selected as lectotype.

heteromalla, Tram. Cke. G. 10:132, 1882. S. Wales, Australia.
= **Coriolopsis polyzona** (Pers.) Ryv.

hobsonii, Pol. Cke. G. 15:20, 1886. Bombay, India.
= **Leucophellinus hobsonii** (Cke.) Ryv. comb. nov. Basionym: **Polyporus hobsonii** Cke. Grevillea 15:20, 1886.
This is a prior name for **Leucophellinus mollissimus** (Pat.) Reid. Parmasto (1983) was of the opinion that this species also is represented in North Eastern Asia (described as **Leucophellinus irpicoides** (Pil.) Bond.). However, as already pointed out by Parmasto, the North-Eastern population has smaller spores than the tropical one, and for the time being I prefer to keep them as two species. The tropical specimens are almost always pileate, while those of North East Asia are almost always resupinate. For a description, see Ryvarden & Johansen 1980:453 as **Oxyporus mollissimus** (Pat.) Reid.

holomelanus, Fomes Cke. G. 15:51, 1886. Panuré, Brazil.
= **Polyporus atro-umbrinus** Berk.

holoxantha, Poria Berk. & Cooke. G. 15:26, 1886. Georgia, USA.
= **Perenniporia pulchella** (Schw.) Ryv. as indicated by Lowe (1966:111).

hyperborea, Poria Cke. G. 15:27, 1886. North America.
= Nomen nudum. There is one specimen in the Kew herbarium, which is a resupinate specimen of **Trichaptum biformis** (Fr. in Kl.) Ryv.

hypolateritia, Poria Cke. G. 15:24, 1886. India.
= **Tyromyces hypolateritia** (Cke.) Ryv. For a description see Ryvarden and Johansen 1980:608.

hypomelanus, Pol. G. 15:51, 1886. New Zealand.
= Accepted in the genus, for a description see Cunningham (1965: 136). The species is close to **Polyporus gayanus** Lév. which was described from the **Nothofagus**-forests in Chile. The two species may ultimately prove to be the same.

hyposclerus, Pol. Cke. G. 10:103, 1882. Australia.
= **Rigidoporus vinctus** (Berk.) Ryv.

hystriculus, Pol. Cke. G. 15:16, 1886. Melbourne, Australia.
= **Tyromyces pelliculosus** (Berk.) Cunn. as already cited by Cunningham (1965:124).

hystrix, Tram. Cke. G. 9:98, 1881. Mauritius.
= **Hexagonia hirta** Fr. as indicated by M.E.P.K. Fidalgo on the sheet.

illuda, Daeda. Cke. G. 21:37, 1892. Victoria, Australia.
= **Datronia brunneo-leuca** (Berk.) Ryv. comb. nov. Basionym: **Polyporus brunneo-leucus** Berk. Lond. J. Bot. 5:4, 1846. For a description, see Ryvarden & Johansen 1980:285.

incurvus, Pol. Cke. G. 13:2, 1884. Perak, Malaysia.
= **Rigidoporus incurvus** (Cke.) Ryv. comb. nov. Basionym: **Polyporus incurvus** Cke. Grevillea 13:2, 1884.
Basidiocarp laterally stipitate, pileus fanshaped, up to 3 cm

wide and 4 mm thick, woody hard when dry, upper surface dull, ochraceous with narrow pale gray zones, stipe 3 cm high, 3-4 mm in diam, ochraceous, glabrous, pore surface pale reddish brown, probably more pinkish when fresh, pore invisible to the naked eye, 7-8 per mm, tubes concolorous with pore surface, up to 3 mm deep and distinctly darker than the context, the latter fibrous, and ochraceous, up to 1 mm thick.

Hyphal system monomitic, generative hyphae with simple septa, in the context 4-8 µm wide with thick walls and scattered septa, in parts swollen to 30 µm and reminding of imbedded smooth cystidia, in the trama agglutinated, narrower and more thin-walled, no cystidia seen, mammilate cystidiols few and scattered, smooth, up to 25 x 8 µm, spores globose, thin-walled, hyaline, IKI-, 3-4 µm in diameter. Only the type has been seen.

R. biokoensis (Lloyd) Ryv. has a similar basidiocarp, but the spores are larger and cystidia are present in the hymenium. The simple-septate hyphae, the globose spores and the mammilate cystidiols clearly place **P. incurvus** in **Rigidoporus**. The pore surface has the same colour as in dried specimens of **R. lineatus** (Pers.) Ryv. and **R. microporus** (Fr.) Overeem and like these species, the pore surface of **R. incurvus** is probably orange to pink in fresh condition.

introstuppeus, Pol. Cke. G. 13:2, 1884. N.W. India.
= **Fomes fomentarius** (L.:Fr.) Kicks.

kurzianus, Polyst. Cke. G. 15:22, 1886. Java.
= **Trametes menziesii** (Berk.) Ryv.

laetus, Pol. Cke. G. 19:103, 1891. Victoria, Australia.
= **Rigidoporus laetus** (Cke.) Buch. & Ryv. For a description, see Cunningham (1965:196).

laevis, Hexagonia Cke. G. 19:103, 1891. Andaman Islands.
= **Daedalea sulcata** (Berk.) Ryv. For a description, see Mitra and Roy (1984).

laeteritius, Pol. Cke. G. 9:12, 1880. Rio de Janeiro, Brazil.
= **Pyrofomes laeteritius** (Cke.) Ryv. Norw. J. Bot. 19:236, 1972.

Basidiocarp perennial, woody, applanate, broadly attached, semicircular, up to 15 cm in diameter, 5 cm thick at the base, upper surface smooth and initially covered with a pale brown to brick red tomentum, apparently soon becoming glabrous exposing a darker reddish brown surface, slightly pitted and warted, but no distinct cuticle present, pore surface yellowish brown, pores round and thick-walled, almost invisible to the naked eye, 7-9 per mm, tubes concolorous, up to 3.5 mm deep and stratified, context up to 3 cm thick, brick red to orange brown, cherry red with KOH, changing to black at drying.

Hyphal system trimitic, generative hyphae hyaline and with clamps, 1-3 µm wide, very difficult to find in the type specimen, skeletal hyphae yellow to rusty brown, 2-6 µm wide, binding hyphae sparsely branched, yellowish, 2-3 µm wide,

cystidia and basidia not observed, spores thick-walled, globose to slightly truncate, hyaline to slightly thick-walled, IKI negative, 5-6 x 4.5-5.5 µm.
Known from Brazil, besides the type collection, specimens have also been seen from Amazonas (Herb. NY).

leucocreas, Pol. Cke. G. 8:55, 1879. New Zealand.
= **Piptoporus portentosus** (Berk.) Cunn. as already indicated by Cunningham 1965:106.

leucospongia, Pol. Cke. & Harkness. G. 11:106, 1883. California, USA.
= **Oligoporus leucospongia** (Cke. & Hark.) Gilbn. & Ryv. For a description, see Gilbertson & Ryvarden (1987:474).

lividus, Pol. Cke. G. 10:131, 1882. Clarence River, Australia.
= Illegitimate name, homonym of **P. lividus** Kalch. Grevillea 10:103, 1882.

luridus, Pol. Cke. G. 12:21, 1883. Name change for **Pol. lividus** Cke., non Kalch..
= **Perenniporia tephropora** (Mont.) Ryv.

makuensis, Polyst. Cke. G. 16:25, 1887. Makua, Mozambique.
= **Microporus vernicipes** (Berk.) Kunt.

malaiensis, Polyst. Cke. G. 14:13, 1885. Perak, Malaysia.
= **Phellinus discipes** (Berk.) Ryv.

membranacincta, Poria Cke. G. 15:26, 1886. Tasmania.
= **Tyromyces merulinus** (Berk.) Ryv.

microsticta, Daedalea Cke. G. 10:122, 1882. Rio de Janeiro, Brazil.
= Accepted in the genus. For a description, see Fidalgo & Fidalgo (1967:848).

muelleri, Daed. Cke. G. 19:93, 1891. Victoria, Australia.
= **Lenzites elegans** (Fr.) Pat.

mylittae, Pol. Cke. & Mass. G. 21:37, 1892. Victoria, Australia.
= Accepted in the genus. For a description, see Cunningham (1965:81).

neaniscus, Polyst. Cke. G. 15:24, 1886. Type locality unknown.
= **Trametes versicolor** (Fr.) Pil.

nebularis, Polyst. Cke. G. 15:23, 1886. Rio de Janeiro, Brazil.
= **Trichaptum sector** (Fr.) Kreisel.

nigrescens, Polyst. Cke. G. 20:90, 1892. Brazil.
= **Nigroporus vinosus** (Berk.) Murr.

nigrolaccatus, Pol. Cke. G. 9:97, 1881. Mauritius.

= **Ganoderma galagensis** (Mont.) Pat. Noted on the sheet by Bresadola.

nivea, Lenz. Cke. G. 15:94, 1887. Queensland, Australia.
= **Lenzites vespacea** (Pers.) Ryv.

oblinitus, Fomes Cke. G. 15:22, 1886. Mauritius.
= **Coriolopsis sanguinara** (Kl.) Ryv. based on the same type specimen as that of Klotzsch species.

obstinatus, Tram. Cke. G. 10:17, 1883. Endeavour River, Australia.
= **Trametes meyenii** (Kl.) Lloyd as already indicated by Cunningham (1965:168).

ochroflava, Tram. Cke. G. 9:12, 1880. Rio de Janeiro, Brazil.
Accepted in the genus.
Type: Brazil, Rio de Janeiro, Glaz. 11769.
Basidiocarp pileate, applanate, semicircular, dimidiate to partly sessile, woody, 10 cm long, 5 cm wide, 2 cm thick at the base, margin rounded, appr. 5-8 mm thick, upper surface pale brown to dark ochraceous today, tuberculate, glabrous, dull, slightly zoned at the margin, pore surface concolorous, margin wide and sterile, pores round to slightly angular, thick-walled, 4-5 per mm, hardly visible to the naked eye because of the thick pore-walls, tubes concolorous, up to 1 cm deep, context dense, dark ochraceous, up to 1.5 cm at the base.
Hyphal system trimitic, generative hyphae hyaline with clamps, 2-4 µm wide, very difficult to find in the type, skeletal hyphae dominant, 3-6 µm wide, thick-walled, but with distinct lumen, unbranched, slightly flexous, embedded and not easily separated, binding hyphae few and only fragments observed. No hymenium present, and no spores and basidia seen. This species is unknown to me, but should be easy to recognize in the field because of the even ochraceous colour which probably has darkened over the years compared with fresh condition. **Trametes elegans** (Fr.) Fr. in its poroid state may remind of this species, but has a white context and the pores are larger. The species seems to be correctly placed in **Trametes** with its trimitic hyphal system and as long as we do not know the type of rot.

omaena, Poria Cke. G. 15:26, 1886. Carolina, USA.
= The type is apparently lost.

palisserii, Pol. Cke. G. 10:98, 1882. Victoria, Australia.
= **Trametes cingulata** Berk.

parishii, Polyst. Cke. G. 15:51, 1886. Moulmein, India.
= **Earliella scabrosa** (Pers.) Gilbn. & Ryv.

perdurans, Pol. Kalch. & Cke. G. 9:1, 1880.
= The type is lost.

phlebiaformis, Poria Cke. G. 15:24, 1886. Cuba.
= **Hapalopilus phlebiaformis** (Cke.) Ryv. Mycotaxon 28:528, 1987. For a description, see Lowe 1966:125.

Page 54 line 6 *for* sanguinara (Kl.) Ryv. *read* sanguinaria (Kl.) Teng

ERRATA, VOLUME THIRTY-ONE

Page 54 line 47 for phlebiaformis read phlebiaeformis
48 for phlebiaformis read phlebiaeformis

pinguedinea, Poria Cke. G. 15:25, 1886.
= Nomen nudum, illegitimate name.

placentaeformis, Polyst. Cke. G. 15:24, 1886. Canada.
Grevillea 15:24, 1886, Carlton, Br. North America.
The type collection is mixed and consists of two small, immature and badly developed specimens. The smallest one may be a young specimen of a **Coriolopsis** species because it has a brown context and a tomentose pileus with a trimitic hyphal system. The other specimen has a split hymenophore and may have been resupinate when fresh while the margin loosened and curled up during the drying. No hymenium is developed in either of the two specimens.
The name should be dropped as a nomen ambigum.

platyphyllus, Lenz. Cke. G. 13:1, 1884. Perak, Malaysia.
= **Lenzites acuta** Berk.

popanoides, Pol. Cke. G. 9:97, 1881. Mauritius.
= **Amylosporus campbellii** (Berk.) Ryv.

porothelioides, Poria Cke. G. 15:27, 1886. Venezuela.
= **Antrodia porothelioides** (Cke.) Ryv. comb. nov. Basionym: **Poria porothelioides** Cke. Grevillea 15:17, 1886.
Basidiocarp annual, detachable, resupinate, tough, up to 3 mm thick, margin whitish and with rhizomorphs, surface ochraceous today (white when fresh?), pores angular, rather thin-walled, 6-7 per mm, tubes concolorous, context tough and fibrous, white to wood-coloured, 1-2 mm thick.
Hyphal system dimitic, generative hyphae with clamps, difficult to observe in the type, 2-3 µm wide, skeletal hyphae dominating, rather narrow, 1.5-3 µm wide, IKI-, basidia 4-sterigmate, 12-15 x 4-5 µm, spores hyaline, thin-walled, IKI-, ellipsoid to subcylindrical, 5.5-6.5 x 2.5-3 µm. On deciduous wood.
This species reminds of **A. gossypia** (Speg.) Ryv. because of the rhizomorphs and relatively large ellipsoid spores. However, it is separated by its larger spores (4-5.5 µm long in **A. gossypia**) and smaller pores.

porriginosa, Poria Cke. G. 15:26, 1886. Bombay, India.
= No structure present, only a mycelial mat. Nomen dubium.

proteiformis, Polyst. Cke. G. 14:81, 1886. Australia.
= **Trametes marianna** (Pers.) Ryv. Namechange for **Pol. proteus** Kalch. 1882, non Berk. 1843.

proteiporus, Pol. Cke. G. 12:15, 1883. Inochomba, Queensland, Australia.
= **Abortiporus biennis** (Bull.:Fr.) Murr. as indicated by Cunningham (1965:82).

purpurea, Tram. Cke. G. 10:121, 1882. Japan.
= **Daedaleopsis purpurea** (Cke.) Imaz. & Aoshima. For a description, see Imazeki and Aoshima (1967:619).

purpureo-fuscus, Polyst. Cke. G. 15:24, 1886. South Carolina, USA.
= **Phellinus gilvus** (Schw.) Pat.

pyrrochreas, Fomes Cke. G. 14:11, 1885. New Guinea.
= **Pyrofomes albomarginata** (Lév.) Ryv. as already noted by Bresadola on the sheet.

regulicolor, Fomes Cke. G. 15:21, 1886. Cuba.
= **Amauroderma schomburgkii** (Berk.) Torr. as already noted by Bresadola on the sheet.

retriporus, Pol. Cke. G. 12:15, 1883. Australia.
= **Bondarzewia berkeleyi** (Fr.) Bond. & Sing.

rhinocerus, Fomes Cke. Trans. Bot. Soc. Edinburgh. 13:150, 1879.
= **Lignosus rhinocerus** (Cke.) Ryv. For description, see Ryvarden & Johansen (1980:408).

rigescens, Polyst. Cke. G. 14:12, 1885. Perak, Malaysia.
= **Antrodiella liebmannii** (Fr.) Ryv.

rufitincta, Poria Cke. G. 15:25, 1886. Cuba.
= **Phellinus rufitinctus** (Cke.) Ryv. For a description, see Ryvarden & Johansen (1980:210).

rufopictus, Polyst. Cke. G. 15:23, 1886. Cuba.
= **Rigidoporus lineatus** (Pers.) Ryv.

salleana, Poria Cke. G. 15:25, 1886. Cordova, Argentina.
= **Gloeoporus** cfr. **dichrous** (Fr.) Bres. The type is sterile and in a bad condition.

salpinctus, Pol. Cke. G. 8:142, 1880. New Zealand.
= **Coltricia salpinctus** (Cke.) Cunningh. For a description, see Cunningham (1965:194).

sepiater, Pol. Cke. G. 9:100, 1880. Rio de Janeiro, Brazil.
= **Rigidoporus microporus** (Fr.) Overeem.

setiger, Pol. Cke. G. 20:1, 1890. New Zealand.
= **Tyromyces setiger** (Cke.) Cunningh. For a description, see Cunningham (1965:120).

siennaecolor, Polyst. Cke. G. 15:22, 1886. Panuré, Brazil.
= **Antrodiella versicutis** (Berk. & Curt.) Ryv.

sinensis, Lenz. Cke. G. 17:75, 1889. China.
= **Daedaleopsis tricolor** (Fr.) Schroet.

socotrana, Tram. Cke, G. 11:39, 1882. Socotra, Tanzania.
= Accepted in the genus, for a description, see Ryvarden & Johansen (1980:584).

sordidus, Pol. Cke. G. 15:20, 1886. USA.
= Illegitimate name, homonym of **P. sordidus** Berk. in Fr. 1851. The type of the illegitimate name is a specimen of

Fomitopsis spraguei (Berk.) Gilbn. & Ryv.

spiculiferus, Pol. Cke. G. 15:20, 1886. Australia.
= **Fistulina spiculifera** (Cke.) Reid. For a description, see Reid (1963:280)

subaurantia, Poria Cke. G. 15:27, 1886. Carolina, USA.
= **Perenniporia subacida** (Peck) Donk, as already indicated on the sheet by Bresadola.

subcongener, Daed. Cke. G. 10:133, 1882. Australia.
= Nomen nudum and illegitimate.

subtenuis, Hexagonia Cke. G. 010:133, Australia.
= **Hexagonia tenuis** (Hook.) Fr.

subzonalis, Pol. Cke. G. 19:44, 1890. Australia.
= **Trametes menziesii** (Berk.) Ryv.

sulcatus, Pol. Cke. G. 13:32, 1884. Demarara, Brazil.
= **Perenniporia martius** (Berk.) Ryv.

talpae, Pol. Cke. G. 16:15, 1887. Minas Geras, Brazil.
= **Laetiporus percicinus** (Berk. & Curt.) Gilbn.

tegillaris, Poria Cke. G. 15:25, 1886. Carolina, USA.
= Unknown identity, the type is badly developed, sterile, and badly contaminated. Nomen dubium.

tenellus, Pol. Cooke & Ellis G. 7:81, 1878. New Jersey, USA.
= **Ceriporia tarda** (Berk.) Ginns.

tomentocincta, Poria Cke. G. 15:26, 1886. Carolina, USA.
= **Perenniporia pulchella** (Schw.) Ryv. as already stated by Bresadola on the sheet.

trizonatus, Pol. Cke. G. 12:17, 1883. Yarra, Australia.
= **Microporus affinis** (Blume & Nees:Fr.) Kunt.

description.

tumulosus, Pol. Cke. G. 17:55, 1889. Australia.
= Accepted in the genus. For a description, see Cunningham (1965:78).

veluticeps, Pol. Cke. G. 13:6, 1884. Mozambique.
= **Microporus concinnus** (Fr.) Kunt. as indicated by D.A. Reid on the sheet.

venezuelae, Pol. Cke. G. 15:20, 1886. Venezuela.
= **Fomitella supina** (Schwartz) Murr.

victoriae, Pol. Cke. G. 8:55, 1879. Victoria, Australia.
= **Phellinus wahlbergii** (Fr.) Reid.

zealandicus, Pol. Cke. G 8:55, 1879. New Zealand.
= **Phellinus wahlbergii** (Fr.) Reid.

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TAXONOMIC STUDIES IN THE GENUS *MYCOSPHAERELLA*. SOME SPECIES OF *MYCOSPHAERELLA* ON BRASSICACEAE IN CANADA

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Descriptions and illustrations of 4 species of *Mycosphaerella* (*M. brassicicola*, *M. cruciferarum*, *M. densa* and *M. tassiana*) occurring on Brassicaceae are provided. A key to the species and a host index are also given.

Le auteur décrive et illustre 4 espèces de *Mycosphaerella* (*M. brassicicola*, *M. cruciferarum*, *M. densa* and *M. tassiana*) venant sur les Brassicaceae. Un clef des espèces et un index des hôtes sont également présentés.

Introduction

The genus *Mycosphaerella* Johanson was established by Johanson (1884, p.163) as a new name for *Sphaerella* (Fr.) Rabenh., a later homonym of the algal genus *Sphaerella* Sommerfelt published in 1824. *Mycosphaerella* is based on *Sphaeria* subgenus *Sphaerella* Fr. (1849, p. 395), erected for several species of *Sphaeria* possessing immersed inconspicuous ascomata on dried leaves. Of the seven species listed by Fries, three of them, *Sphaeria maculaeformis* Pers.: Fr., *S. punctiformis* Pers.: Fr. and *S. recutita* Fr. are currently retained in *Mycosphaerella.* Although its nomenclatural status has long been a controversial subject as summarized by Holm (1975, p 482, 484-5), *Sphaerella* sensu Fries is now generally accepted (Müller & von Arx 1962, p. 353; Barr 1972, p. 582; Holm 1975, pp. 485-6; Tomilin 1979, p. 7; Sivanesan 1984, p. 182) to have been used first at the generic level by Rabenhorst (1856). On some but not all packet labels of the exsiccatus specimen in Klotzchii Herb. vivum mycol., edition 2, cent. 3, no. 264, 1856 (fide Holm, p. 484-5) and in Bot. Zeit. 14:445. June 1856, Rabenhorst listed "*Sphaerella punctiformis* (Pers.)Fr. Summa. 396. var. *perexigua* Desmaz.", thus providing a direct reference to Fries' publication of subgenus *Sphaerella*. As pointed out by Holm (1975, p. 485), Rabenhorst incorrectly cited Fries as having published *Sphaerella* at the generic level but Rabenhorst is to be credited, albeit unintentionally, with the transfer to generic rank. Later, Fuckel (1870, p. 99) used *Sphaerella* (Fr.) at the generic level, characterizing the genus as having very small perithecia, 8-spored fasiculate asci and more or less oval, hyaline 2-celled ("..2 zellige,..") ascospores. He listed over fifty species mostly on living or dead leaves and included three of the seven species listed by Fries including *Sphaeria punctiformis* Pers.: Fr. *Sphaerella* (Fr.) Fuckel would be both a later homonym and obligate synonym of *Sphaerella* (Fr.) Rabenh. Cesati and de Notaris (1863, p. 236-8) meanwhile erected the genus *Sphaerella* Ces. & de Not. without any reference to *Sphaerella* (Fries) and did not include any of Fries' species. *Sphaerella* of Cesati and de Notaris comprises species with 1- or 2-septate or rarely non-septate ascospores. Auerswald (1869, pp. 1-20), although not citing the generic authority, used *Sphaerella* in the sense of Cesati & de Notaris. Saccardo accepted *Sphaerella* Ces. & de Not. in volume 1 of the Sylloge (1882, p. 476), pro parte, retaining in *Sphaerella* only species with one-septate ascospores. *Sphaerella* Ces. & de Not. is listed as a facultative synonym of *Mycosphaerella* in the seventh edition of Ainsworth & Bisby's Dictionary of the Fungi, (Hawksworth et al. 1983, p. 357) and as a synonym of the genus by von Arx (1949, p. 32), Müller & von Arx (1962, p. 353) and by Eriksson & Hawksworth (1986, p. 254). I would certainly agree that *Sphaerella* Ces. & de Not. in the restricted sense of Saccardo (1882) for species with 1-septate ascospores is a facultative synonym of *Mycosphaerella* Johans.

Because of the large number of *Mycosphaerella* and *Sphaerella* names in the literature no true world monograph of the genus *Mycosphaerella* exists at this time. Most of the recent comprehensive taxonomic works are either regional treatments such as those by von Arx (1949) and Müller & von Arx (1962) on some European species and by Barr (1959, 1972) on the North American species or host limited treatments such as those by Holm and Holm (1979) on the Swedish species occurring on ferns and Evans (1984) on the species found on *Pinus*. Sivanesan's recent book (1984) deals with the species possessing well documented anamorphs. Tomilin's treatment (1979) of over 600 species or names arranged by host family perhaps comes closest to being a world monograph.

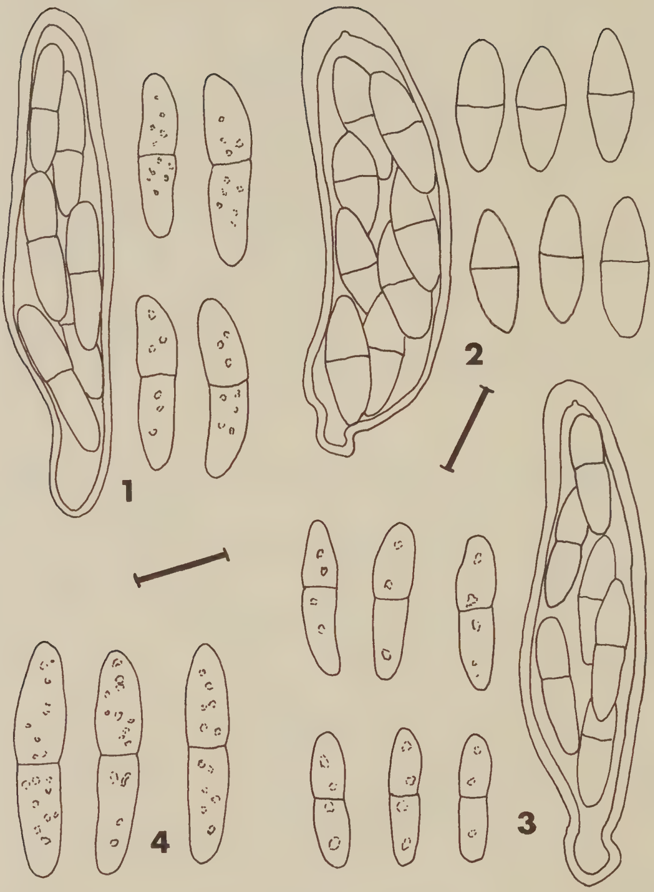
The present study is concerned with some species of *Mycosphaerella* occurring as saprophytes and/or pathogens on native and cultivated members of the the agriculturally important family Brassicaceae in Canada. The *Mycosphaerella* collections at the National Mycological Herbarium (DAOM) have been the principal source of material for this taxonomic study.

Key to the Species based on Fungus Morphology, Anamorphs

1. Asci saccate, few; ascospores up to 30µm long; anamorph a *Cladosporium* — *M. tassiana*
1. Asci elongate, numerous; ascospores less than 30µm long; anamorph other than *Cladosporium* or none — 2.

2. Ascomata and pycnidia in conspicuous pale spots on *Brassica* species; anamorph an *Asteromella* — *M. brassicicola*
2. Pale conspicuous spots absent; anamorphs apparently lacking or unconfirmed — 3.

3. Ascomata grouped in shiny black often stroma-like aggregations; ascospores 14-22x3-4.5µm, clavate, tapering to base — *M. densa*
3. Ascomata in dull blackened zones with abundant dark subepidermal hyphae; ascospores 13-15.5x3.5-5µm, fusoid to ellipsoid — *M. cruciferarum*



FIGURES 1-4, asci and ascospores. Fig. 1. *Mycosphaerella brassicicola*, DAOM 118312. Fig. 2. *Mycosphaerella cruciferarum*, DAOM 63458. Fig. 3. *Sphaerella densa*, ex type and *Mycosphaerella densa*, DAOM 70507. Fig. 4. *Dothidella sphaerelloides*, ex type. (scale = 10μm)

Species descriptions

Mycosphaerella brassicicola (Duby) Lindau, in Engler & Prantl, Die Naturl. Pflanzenf. 1(1):424. Feb. 1897. (FIGS. 1, 7-12)
=*Sphaeria brassicicola* Duby, Botanicon Gallicum 2:712. 1830, as *brassicaecola*, non *Sphaeria brassicicola* Berk. & Br., apud Berk., Outlines Br. Fungol. p. 401. 1860.
=*Sphaerella brassicicola* Ces. & de Not., Comment. Soc. critt. ital. 4:238. 1863, as *brassicaecola*.
=*Mycosphaerella brassicicola* (Duby) Oudem., Rév. Champ. Pays-Bas. 2:210. March 1897, as *brassicaecola*.

Anamorph: *Asteromella brassicae* (Chev.) Boerema & van Kesteren, Persoonia 3:18. 1964.

Ascomata mostly on leaves but also on stems and fruits, numerous, gregarious, immersed, becoming erumpent, globose to subglobose to somewhat flattened, 90-145µm wide X 90-125µm high, medium brown to dark brown, papillate, ostiole 16-20µm across. Ascoma wall 9-12µm thick, composed of 3-4 layers of medium to dark reddish brown angular pseudoparenchymatous cells, up to 6.5 X 4.5µm, increasingly paler to the inside. Pseudoparaphyses lacking. Asci bitunicate, numerous, elongate to clavate, 8-spored, 30-47(55) X 12-16µm. Ascospores hyaline, cylindrical, straight or curved, 16-25 X 3-4µm, septate in the middle, constricted or not constricted at septum, upper cell sometimes slightly broader than lower cell but generally uniform in width, ends rounded, hyaline, wall smooth, irregularly biseriate in the ascus.

Pycnidia globose to subglobose, sometimes flattened, 70-85(100)µm wide by 65-80µm high. Pycnidium wall 12-15µm thick, composed of 2-4 layers of angular reddish brown pseudoparenchymatous cells, ca 4-5µm diam. Pycnidiospores (spermatia) cylindrical, straight or curved, 3-5.5 X 1µm, hyaline.

Parasitic on leaves of *Brassica* species. Collections examined: On *Brassica oleracea* L. var. *botrytis* L. (cauliflower). CANADA: BRITISH COLUMBIA: Saanichton, Research Stat., DAOM 118311 (SBC 74), coll. W. Jones, March, 1934. On *Brassica oleracea* L. var. *capitata* L. (cabbage). CANADA: BRITISH COLUMBIA: Saanichton, DAOM 118309 (SBC 508), coll. W.J., July 1940; DAOM 118310 (SBC

648), coll. I. Mounce, 1 April 1942. Keating, DAOM 118312 (SBC 608), coll. W.J., July 1941. On *Brassica oleracea* L. var. *gongyloides*. NEW ZEALAND: Auckland City, Mt. Albert, DAOM 178265 (ex herb. PDD 34682), coll. B.H.C. McKenzie, 12 Feb. 1976. On *Brassica oleracea* L. var. cultivated. U.K.: NORTHERN IRELAND: Belfast, DAOM 2279, coll. H.T. Güssow, Aug. 1934. FRANCE: C. Roumeguère, F. gall. exsicc. 1602. On Brassica. FRANCE: Grand Quevilly, Rabenh., F. europ. 2754, coll. Letendre, 1882.

Three additional collections from the U.S.A., ex herb. TRTC, were examined: on *B. oleracea* var. *botrytis*, from Colma, California, coll. M.W. Gardner, 6 Dec. 1933; on *B. oleracea* var. *acephala* DC from Toledo, Oregon, coll. M.J. Conklin, 7 Jan. 1927; on *B. oleracea* var. *capitata* from Couperville, Washington, coll. F.D. Heald & L.M. Freeman, 21 July 1939. Unfortunately these collections, although apparently *M. brassicicola*, were immature. The California collection possesses a few ascospores but asci and ascospores were not seen in the other two collections. Barr (1953) cited several collections of *M. brassicicola* from herb. UBC; two or three of her citations are from Saanichton, British Columbia and are probably the ones examined in this study.

Mycosphaerella brassicicola produces a conspicuous pale grey-brown circular lesion up to 2 cm across, bounded by a narrow chlorotic zone (ring spot) on the outer leaves of *Brassica* species. Large numbers of spermatial pycnidia followed by ascomata are produced in the lesions mostly on the upper (outer) leaf surface although some fructifications are hypophyllous.

Punithalingam & Holliday (1969) provided a description and illustrations of *M. brassicicola* and references to the pathological literature. The life history of the fungus was described by Dring (1961) and Boerema & van Kesteren (1964) resolved the nomenclatural confusion, providing full synonymy for both teleomorph and anamorph.

Mycosphaerella cruciferarum (Fr.) Lindau, in Engler & Prantl, Die Naturl. Pflanzenf., Leipzig 1(1):424. 1897. (FIGS. 2, 13-15)

=*Sphaeria cruciferarum* Fr., Syst. Mycol. 2:315. 1823.

=*Sphaerella cruciferarum* (Fr.) Sacc., Michelia 2:315. 1881.

=*Sphaerella cruciferarum* (Fr.) v. Höhnel, Ber. Deut. Bot. Ges. 36:314. 1918.

Ascomata subepidermal in the stems, numerous, gregarious, immersed, becoming erumpent, connected by strands of medium brown hyphae radiating from individual ascomata, subglobose to somewhat depressed, 84-125µm wide by 70-100µm high, dark brown; ostiole 14-18µm across, neck conical or short cylindrical, 8-12µm high and ca 20µm wide, apex of ascoma distinctly flattened. Ascoma wall up to 10µm thick, composed of dark to light brown angular pseudoparenchymatous cells, 3-5µm broad. Pseudoparaphyses lacking. Asci bitunicate, thick-walled, elongate, ovoid to obclavate, numerous in a broad fascicle, 8-spored, 34-55 X 9-16µm. Ascospores hyaline, free ascospores appearing pale greenish, fusoid to ellipsoidal at maturity, straight or curved, 13-15.5 X 3.5-5µm, septate in the middle, not constricted at septum, becoming 2-3-septate at maturity, ends somewhat bluntly pointed, wall smooth, bi- to multiseriate in the ascus.

On old stems of various Brassicaceae. Collections examined: On *Draba alpina* L. CANADA: QUEBEC: McClelan Strait, DAOM 63458, coll. R.T. Wilce, 19 July 1955. On *Erysimum cheiranthoides* L. GERMAN DEMOCRATIC REPUBLIC: Brandenburg, Sydow, Mycoth. germ. 1231 in DAOM, coll. P. Vogel, 27 July 1913. On *Eutrema edwardsii* R.Br. CANADA: NORTHWEST TERR.: Baffin I., head of Clyde Inlet, DAOM 63422, coll. P. Dansereau, 27 June 1950.

Barr (1959) considered *Mycosphaerella cruciferarum* to be both common and widespread on Brassicaceae in temperate regions but also to occur in subarctic and arctic areas. The collections examined are characterized by an abundant subepidermal network of hyphae radiating from and connecting individual closely grouped ascomata. The dark ascomata and connecting mycelium are seen as blackened zones up to 1 mm across on the overwintered host twigs.

Mycosphaerella densa (Rostrup) Lind, in Rep. Sci. Res. Norweg. Exped. Nov. Zembl., 1921. 19:12. 1924. (FIGS. 3, 16-21)

=*Sphaerella densa* Rostrup, Botanisk Tidsskr. 14:225. 1885.

Ascomata predominantly epiphyllous but some occurring on lower leaf surface, grouped, rarely separate, connected by masses of red-brown subepidermal hyphae, sometimes so closely grouped as to form shiny blackened stroma-like aggregations, immersed, subepidermal, erumpent, globose, subglobose, or elongate, (76)85-140µm wide by (78)95-150µm high, dark brown to blackish in mass; ostiole 10-25µm across, neck papillate or conical, often apically flattened. Ascoma wall 6.5-12µm thick and 2-3(4) cell layers, composed of medium reddish brown angular pseudoparenchymatous cells up to 11 x 5.5µm, wall cells paler to the inside but a darker red-brown around the neck; the latter when viewed from above, appearing as a darkened doughnut-like ring around each ostiole. Pseudoparaphyses lacking. Asci numerous, bitunicate, thick-walled, fasiculate, oblong to clavate, numerous, 8-spored, 36-54 X 9-11µm. Ascospores hyaline to greenish hyaline, obovoid to clavate, straight or curved, 14-22(24) X 3-4.5µm, septate in the middle, not constricted at septum, upper cell distinctly broader than lower cell, narrowing to the base, straight or curved below, upper end rounded to somewhat pointed, lower end rounded, wall smooth, cells faintly guttulate, biseriate in the ascus.

Saprophytic to parasitic on leaves, sometimes stems, of various plants including members of the Brassiciaceae. Collections examined (selected): On *Braya purpurascens* (R. Br.) Bunge. CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., Clyde Inlet, DAOM 63476, coll. P. Dansereau, 2 July 1950. On *Cardamine bellidifolia* L. GREENLAND: Marchion Sound, ex herb. C, coll. J. Nygaard, 15 Aug. 1921. CANADA: NORTHWEST TERR.: Dist. Franklin, Somerset I., DAOM 70507, coll. D.B.O. Savile, 11 Aug. 1958. Cornwallis I. Resolute Bay, DAOM 70506, coll. D.B.O.S., J.A. Calder & I. Kokkonen, 13 Aug. 1959. Ellef Ringnes I., sw Isachsen, DAOM 75128, coll. D.B.O.S., 1 Aug. 1960. S of Isachsen, DAOM 83310, coll. D.B.O.S., 2 Aug. 1960. On *Cardamine pratensis* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Bray I., DAOM 63069, coll. P.D., 10 Aug. 1950. On *Cochlearia officinalis* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellef Ringnes I. sw Isachsen, DAOM 83311, coll. D.B.O.S., 19 July 1960. Victoria I., DAOM 88156, coll. W.D. Stretton & D.B.O.S., 29 Aug. 1960. On *Draba alpina* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellef Ringes I., Isachsen, DAOM 75132, coll. D.B.O.S., 13 July 1960. On *Draba belli* Holm. Ellef Ringnes I., DAOM 75133, coll. D.B.O.S., 7-8 July 1960. On *Draba lactea* Adams. Dist. Franklin, Somerset I., DAOM 70509, coll. D.B.O.S., 9 Aug. 1958.

According to Barr (1959), *Mycosphaerella densa* is a very common species in arctic regions; it is well represented in DAOM by numerous collections from the Canadian arctic. *M. densa* is a very distinctive species, characterized by the shiny black, often stroma-like, aggregation of densely grouped ascomata on the leaves of host plants and by the basipetally tapering, straight to curved ascospores. The type collection of *Sphaerella densa* on *Arenaria*, coll. Reykjavik, Iceland, ex herb. C agrees quite well with the collections in DAOM cited above. Barr (1959) considered the type of *Dothidella sphaerelloides* Dearn., in herb. DAOM, to be conspecific with *M. densa*. I have some reservations and have not included *S. sphaerelloides* in the synonymy above. The type specimens of *densa* and *sphaerelloides* are alike in their ascoma and ascospore morphology although the ascospores of the latter are larger, the majority being 24-26.5µm long (Fig. 4). The mean ascospore length for the type of *S. densa* and the DAOM collections cited is 16-20µm.

No anamorph has been described for *M. densa* but in one collection, DAOM 70507, on leaves of *Cardamine*, a *Ramularia* species was present along with the ascomata. A brief description of the *Ramularia* is as follows. Dense fascicles of conidiophores arise from brownish substomatal stromata emerging through the stomates. The conidiophores are hyaline to brownish below, septate, up to approximately 40µm long by 3-4µm wide, bear prominent conidial scars, are geniculate and proliferate sympodially and produce the conidia in chains. The conidia are hyaline, cylindrical, tapering slightly at the ends, smooth, 20-45 x 2-3µm, 0-2-septate, bear thickened or refractive broadly flattened scars, 1-1.5µm across at one or both ends. The conidium apex is rounded in the absence of a scar. The association of the two morphs in this collection suggests that the *Ramularia* may be the anamorph of *M. densa*. This remains to be confirmed.

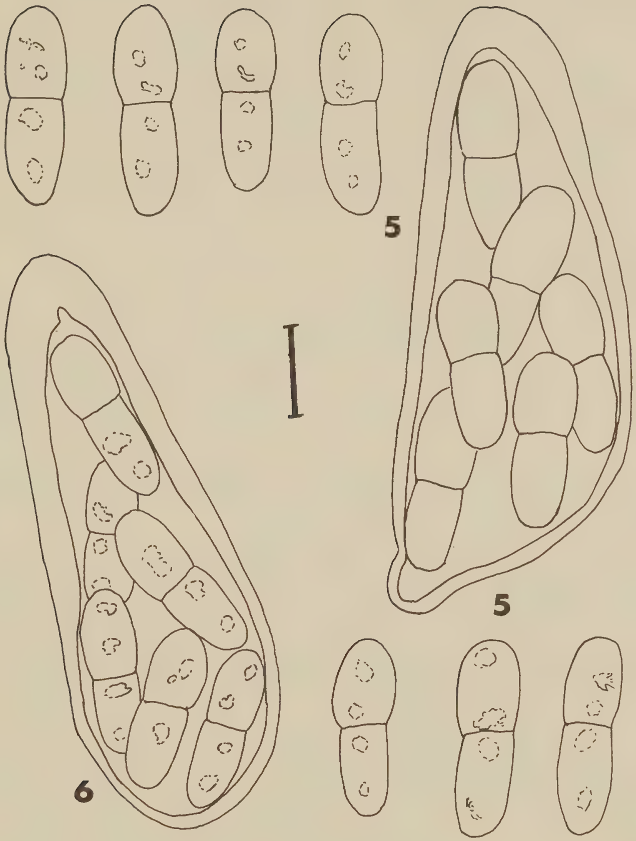
Mycosphaerella tassiana (de Not.) Johans., Ofver. Forh. Kongl. Vet.-Akad. 1884(9):167. 1884 var. *tassiana*. (FIGS. 5, 22-27)
=*Sphaerella tassiana* de Not., Sfer. ital. p. 87. 1863.

Anamorph: *Cladosporium herbarum* (Pers.) Link: S.F. Gray, Nat. Arr. Br. Pl. 1:556. 1821.

Ascomata subepidermal in the stems or leaves, scattered or grouped, immersed, globose to subglobose to conical, 75-155µm wide by 100-155µm high (including neck), dark brown to blackish; neck papillate to conical, erumpent, 15-25µm high and up to 50µm across and apically flattened, ostiole 14-30(34)µm across. Ascoma wall up to 20µm thick, composed of 2-3(4) layers of dark to light brown angular to tangentially flattened pseudoparenchymatous cells, 5-16 X 3-7µm, darker to the outside, darkest around erumpent neck. Pseudoparaphyses lacking. Asci bitunicate, thick-walled, fasiculate, saccate to obclavate, relatively few in number, 8-spored, 45-88 X 15-29(32)µm. Ascospores hyaline to faintly greenish, obovate, straight, 17-31 X 4.5-9.5µm, septate at or near the middle, constricted or not constricted at septum, becoming 2-3-septate at maturity, upper cell often broader, cells usually distinctly biguttulate, sometimes pluriguttulate, ends rounded, wall smooth, uni- to biseriate above and multiseriate at the base of the ascus.

Anamorph colonies on natural substrate or on agar (DAOM 196249 ex CBS 121.49 on PDA & malt agar) olivaceous green to olivaceous brown, velvety; on agar, reverse olivaceous black. Conidiophores straight to flexuous or sometimes geniculate, proliferating sympodially, up to 250µm long (fasiculate and shorter in nature) and 3-6µm wide, with some terminal or intercalary swellings, 7-10µm across, at conidiogenous loci. Conidia in long, often branched chains, ellipsoidal to oblong, pale to medium brown or yellow brown, 5-20 x 3-6µm, 0-1 or more septate, ends rounded with protuberant scars at one or both ends, wall distinctly verruculose.

Saprophytic or weakly parasitic on stems of various plants including members of the Brassicaceae. Collections examined (selected): On *Braya purpurascens* (R. Br.) Bunge. CANADA: NORTHWEST TERR.: Dist. Franklin, Somerset I., DAOM 70713, coll. D.B.O. Savile, 22 July 1958 and Spence Bay, DAOM 70714, coll. D.B.O.S., 19 Aug. 1958. On *Cardamine bellidifolia* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellesmere I., Hazen Camp, DAOM 92860, coll. D.B.O.S., 10 July 1962. On *Cochlearia officinalis* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellef Ringnes I., DAOM 83445, coll. D.B.O.S., 19 July 1960. On *Draba alpina* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Ellef Ringnes I., Isachsen, DAOM 75142, coll. D.B.O.S., 13 July 1960. On *Draba arabisana* (?). CANADA: NEWFOUNDLAND: Labrador, Akak, DAOM 63514, coll. R.T. Wilce (no. 221), 6 Aug. 1954. On *Draba groenlandica* Ekman. CANADA:



FIGURES 5-6, asci and ascospores. Fig. 5. *Mycosphaerella tassiana* var. *tassiana*, DAOM 92860. Fig. 6. *Mycosphaerella tassiana* var. *arctica*, DAOM 70688. (scale = 10µm)

NORTHWEST TERR., Dist. Franklin, Somerset I., DAOM 70716, coll. D.B.O.S., 13 Aug. 1958. On *Draba lactea* (?). CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., Clyde Inlet, DAOM 63421, coll. P. Dansereau, 30 June 1950. On *Lesquerella arctica* (?). CANADA: NORTHWEST TERR., Dist. Franklin, Baffin I., Clyde Inlet, DAOM 62882, coll. P. D., 23 June 1950. On *Parrya arctica* R. Br. CANADA: NORTHWEST TERR.: Dist. Franklin, Victoria I., Cambridge Bay, DAOM 70719, coll. J.A. Calder, D.B.O.S., & I. Kukkonen, 12 August 1959; Victoria I., DAOM 88193 and 88194, coll. W.D. Stretton, 18 Aug. 1960.

Mycosphaerella tassiana is a saprophyte or occasionally a weak parasite which is very common throughout Canada especially in northern regions and at higher altitudes. From the label data available from DAOM collections, this species including all its described varieties (Barr, 1959) is recorded from approximately 60 genera representing about 20 families of dicotlydons and 4 families of monocotyledons. While most of these plant families are represented by only a single genus as a substrate/host, *M. tassiana* occurs more widely in a few families, notably Poaceae, Brassicaceae, Caryophyllaceae, Asteraceae, Rosaceae and Cyperaceae.

Petrie & Vanterpool (1978) reported on a species of *Mycosphaerella* common on overwintered stubble of 'rape' (*Brassica napus* L.), weedy Brassicaceae, Asteraceae and Chenopodiaceae from Saskatchewan and Alberta. The fungus proved to be the ubiquitous *M. tassiana* var. *tassiana* and not as originally thought, *M. brassicicola*, the cause of 'ring spot' of *Brassica* species.

Von Arx (1949) gave an extensive distribution, listing substrate/host species on which *M. tassiana* occurs not only in Europe and also in parts of Asia and the United States. A long list of synonyms of the teleomorph was given by von Arx (1949) while de Vries (1952) provided synonyms of the anamorph. The literature on the association of *Mycosphaerella* (*Sphaerella*) with *Cladosporium* has been summarized in detail by von Arx (1949, 1950, 1983), de Vries (1952) and Barr (1958) and will not dealt with here. Von Arx's taxonomic and nomenclatural studies (1949, 1950) provided convincing proof of the connection between *M. tassiana* and *C. herbarum* by the production of the anamorph from single ascospore cultures. However, *M. tassiana* and its *Cladosporium herbarum* anamorph would appear to be infrequently associated in nature. In the collections examined, the anamorph was rarely encountered.

In one collection, DAOM 70716, the teleomorph is associated with a *Cladosporium* possessing mostly 1-septate, verrucose conidia, 18-20 x 8-10µm which are closer to *Cladosporium macrocarpum* Preuss sensu de Vries (1952) than to *C. herbarum*. The two *Cladosporiums* intergrade and are distinguished principally by the larger, perhaps more verrucose conidia of *macrocarpum*. Barr (1958, p. 510) commented on the variability of the anamorph of *M. tassiana*, saying that "Different strains of the imperfect stage of *M. tassiana* may be considered either *C. herbarum* or *C. macrocarpum*,.... It seems probable that the two species could be united under *C. herbarum*, the earlier name."

Mycosphaerella tassiana var. *arctica* (Rostr.) Barr,
Contr. Inst. Bot. Univ. Montréal 73:24. 1959.
(FIGS. 6, 28, 29)
=*Laestadia arctica* Rostrup, Medd. om Gronland
3:547. 1888.

Saprophytic on old stems and leaves of various plants including members of the Brassicaceae. Collections examined (selected): On *Arabis arenicola* (Richards) Grel. CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., Spence Bay, DAOM 63064, coll. P. Dansereau, 14 July 1950. QUEBEC: Fort Chimo, DAOM 70668, coll. D.B.O. Savile, J.A. Calder & I. Kukkonen, 17 Aug. 1959. On *Cochlearia groenlandica* L. CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., head of Clyde Inlet, DAOM 63057, coll. P. D., 14 June 1950. On *Draba alpina* L. CANADA: QUEBEC: McClelan Strait, DAOM 63458, coll. R. Wilce, 19 July 1955. On *Eutrema edwardsii* R. Br. CANADA: NORTHWEST TERR.: Dist. Franklin, Baffin I., head Clyde Inlet, DAOM 63422, coll. P. D., 27 June 1950.

Barr characterized variety *arctica* as having the ascomata united by abundant dark brown mycelium into large compound stromata evident as blackened areas on the plant tissues. The asci and ascospores of *arctica* are indistinguishable from those of the type variety. Barr discussed the taxonomic status and distribution of variety *arctica* and provided an extensive synonomy. She considered it to be as common as the type variety in arctic and alpine regions of Canada. Variety *arctica* occurs on overwintered stems and leaves of many herbaceous monocotyledons and dicotyledons although on the basis of DAOM specimens, it is much less common on Brassicaceae than the type variety.

Host Index

Arabis arenicola	*M. tassiana*
Brassica oleracea v. *botrytis*	*M. brassicicola*
Brassica oleracea v. *capitata*	*M. brassicicola*
Brassica oleracea v. *gongyloides* (N.Z.)	*M. brassicicola*
Braya purpurascens	*M. tassiana*
	M. densa
Cardamine bellidifolia	*M. tassiana*
	M. densa
Cardamine pratensis	*m. densa*
Cochlearia groenlandica	*M. tassiana*
Cochlearia officinalis	*M. tassiana*
	M. densa
Draba alpina	*M. cruciferarum*
	M. densa
	M. tassiana
Draba belli	*M. densa*
Draba groenlandica	*M. tassiana*
Draba lactea?	*M. densa*
	M. tassiana
Erysium cheiranthoides (G.D.R.)	*M. cruciferarum*
Eutrema edwardsii	*M. cruciferarum*
	M. tassiana
Lesquerella arctica?	*M. tassiana*
Parrya arctica	*M. tassiana*

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FIGURES 7-12. *Mycosphaerella brassicicola*. Fig. 7. Leaf lesion bearing ascomata and pycnidia, DAOM 118312, (X 6.5). Fig. 8. Vertical sections of immature, DAOM 118311 and mature, DAOM 118310, ascomata (X 325). Fig. 9. Ascoma peridium, surface view, DAOM 118312 (X 325). Fig. 10. Pycnidium, vertical section, DAOM 2279 (X 325). Fig. 11. Portion of pycnidium with spermatia (conidia), DAOM 2279 (X 1050). Fig. 12. Asci, ascospores, DAOM 118312 (X 1050). FIGURES 13-14. *Mycosphaerella cruciferarum*. Fig. 13. Ascomata, surface view, Mycoth. germ. 1231 (X 100). Fig. 14. Ascoma, vertical section, Mycoth. germ 1231, (X 325).

FIGURE 15. *Mycosphaerella cruciferarum*. Asci and ascospores, DAOM 63458 (X 1050). FIGURES 16-21. *Mycosphaerella densa*. Fig. 16. Stroma like mass of ascomata on leaf surface, DAOM 70507 (X 25). Fig. 17. Sectioned ascomata on leaves, ex type *Sphaerella densa* (left) and DAOM 70509 (right) (X 85). Fig. 18. Ascoma, vertical section, DAOM 70509 (X 325). Fig. 19. Portion of ascoma wall, vertical section, DAOM 70509 (X 1050).

Fig. 20. Ascospores, ex type *Sphaerella densa* (two ascospores at left) and DAOM 70507 (right) (X 1050).
Fig. 21. *Ramularia* species, fascicle of conidiophores arising from substomatal stroma and conidia, DAOM 70507 (X 1050).

FIGURES 22-27. *Mycosphaerella tassiana* var. *tassiana*. Fig. 22. Ascomata and *Cladosporium* on petioles, surface view, DAOM 70716 (X15). Fig. 23. Ascoma, vertical section, DAOM 70716 (X 325). Fig. 24. Ascus and ascospores, DAOM 92860 (X 1050). Figs. 25 & 26. *Cladosporium macrocarpum*-like anamorph, DAOM 70716: Fig. 25 (X 325), Fig. 26 (X 1050). Fig. 27. *Cladosporium herbarum* conidia, DAOM 196249 (X 1050).
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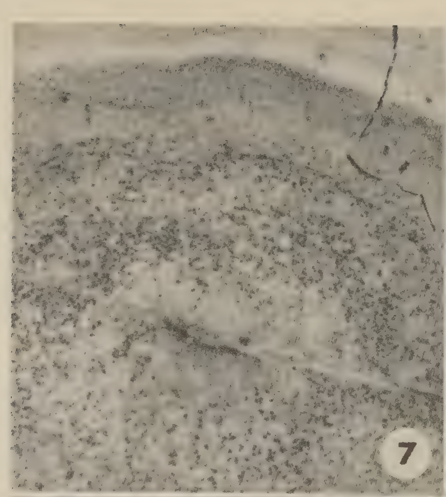
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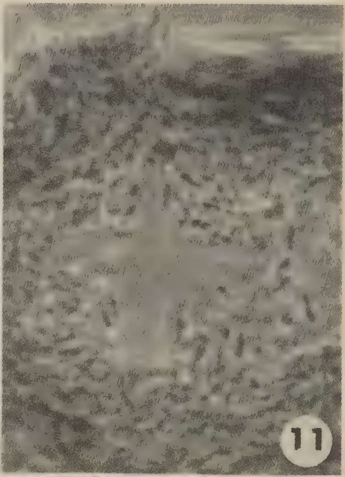
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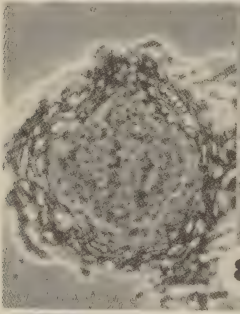
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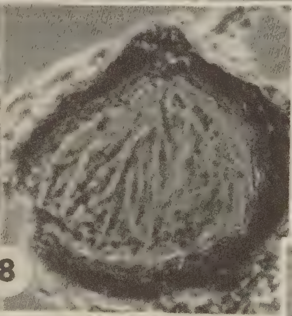

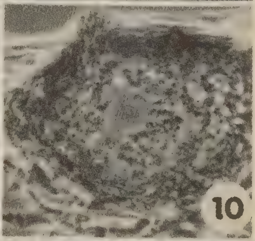
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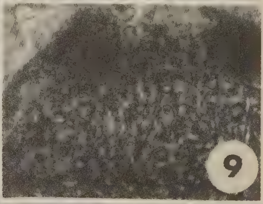
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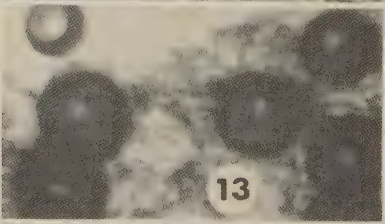
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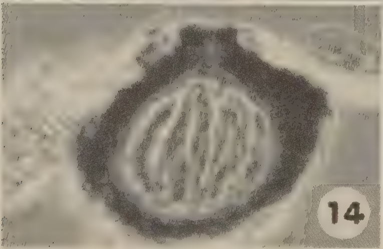
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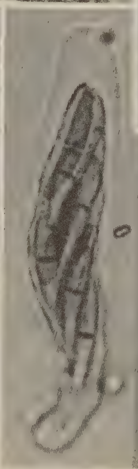

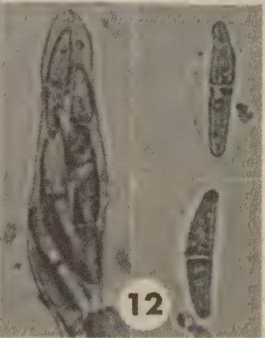
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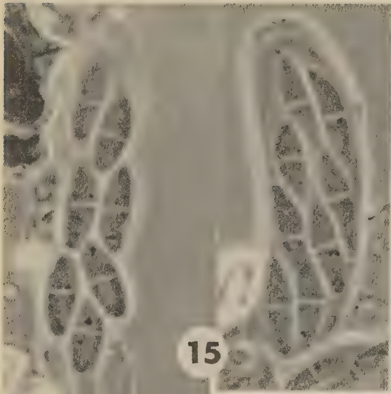

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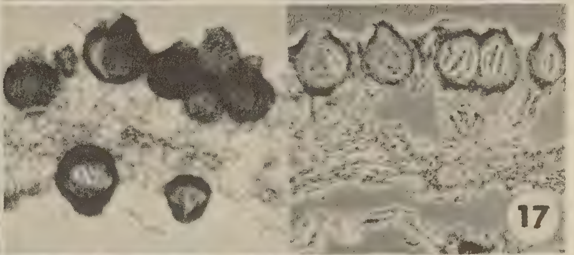

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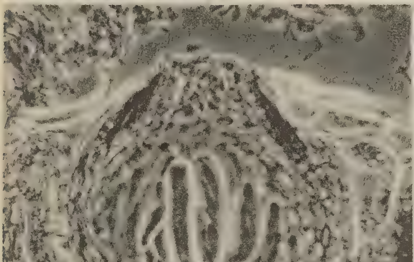

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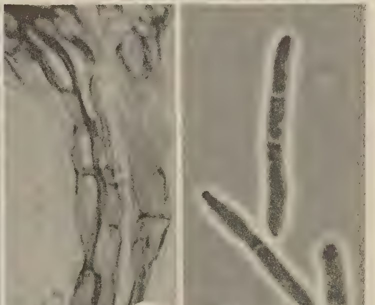

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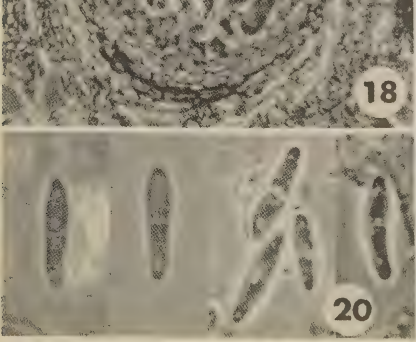

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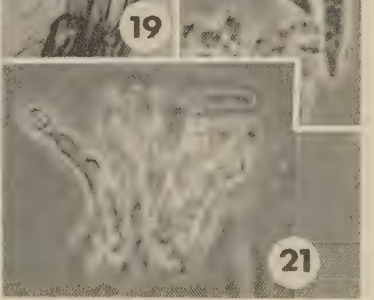

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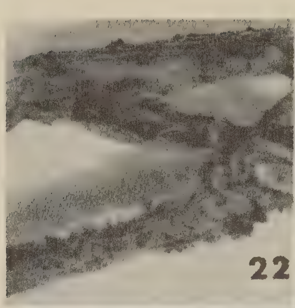
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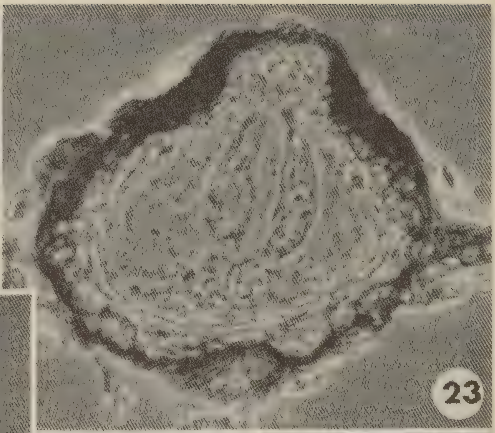
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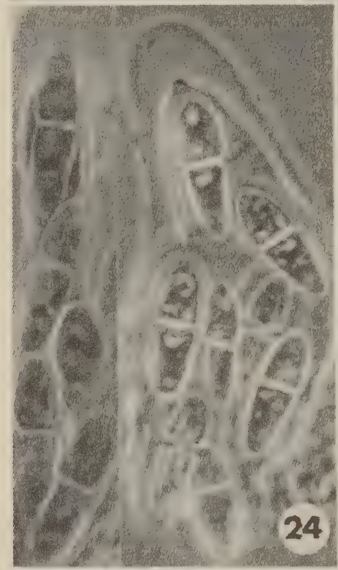
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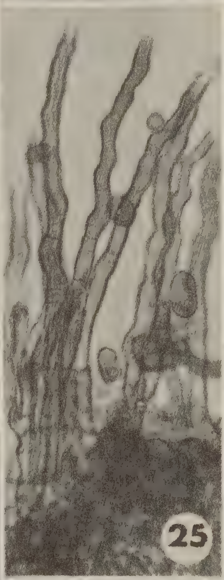
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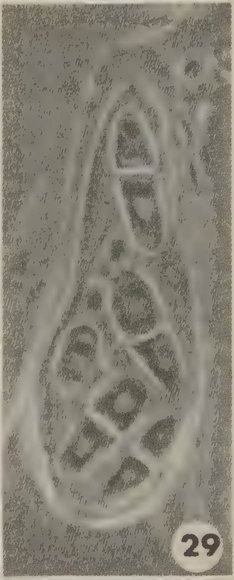
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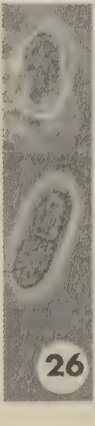
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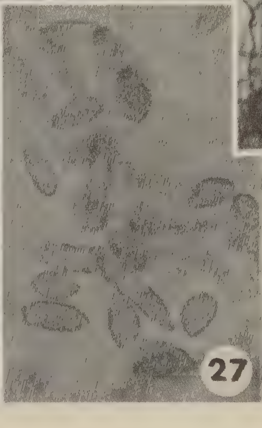
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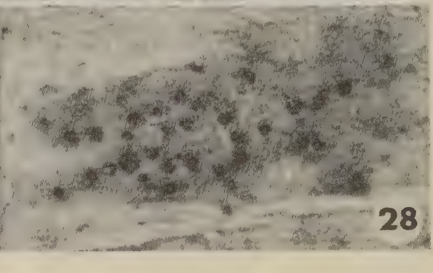
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MYCOTAXON

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FIRST RECORD OF GALERINA NANA (CORTINARIALES) FROM AUSTRALIA

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Abstract

Galerina nana is recorded for the first time from Australia. Collections from South Australia and Victoria are described. Both bi- and tetra-sporic races are represented.

Galerina nana was originally described from Florence Botanic Garden, Italy, by Petri (1903). It has subsequently been reported from Europe (France, Denmark, the British Isles, U.S.S.R.), North America (U.S.A.), the Caribbean (Jamaica), South America (Argentina, Bolivia, Chile), Africa (Kenya) (Singer & Digilio, 1952; Singer, 1969; Smith & Singer, 1964; Dennis, Orton & Hora, 1974 and references therein; Pegler, 1977) and India (Natarajan & Raman, 1983). The only Australasian record of this species is a collection from Little Barrier Island, New Zealand (Horak, 1983). The following description is based upon specimens collected in south-eastern Australia.

Galerina nana (Petri)Kühn., Encyc. Mycol. 7:219, fig. 73, 1935, - Figs 1 & 2.

Naucoria nana Petri, N. Giorn. bot. ital. 10:357, 1903.
N. montana Murr., Mycologia 4:78, 1912.
Galerula velenovskyi Kühn., Bull. Soc. Mycol. Fr. 50:74, 1934 = Inocybe whitei (Berk. & Br.)Sacc. sensu Velenovsky.
Galera nana (Petri)J. Lange, Dansk. Bot. Arkiv. 9(6):44, 1938.

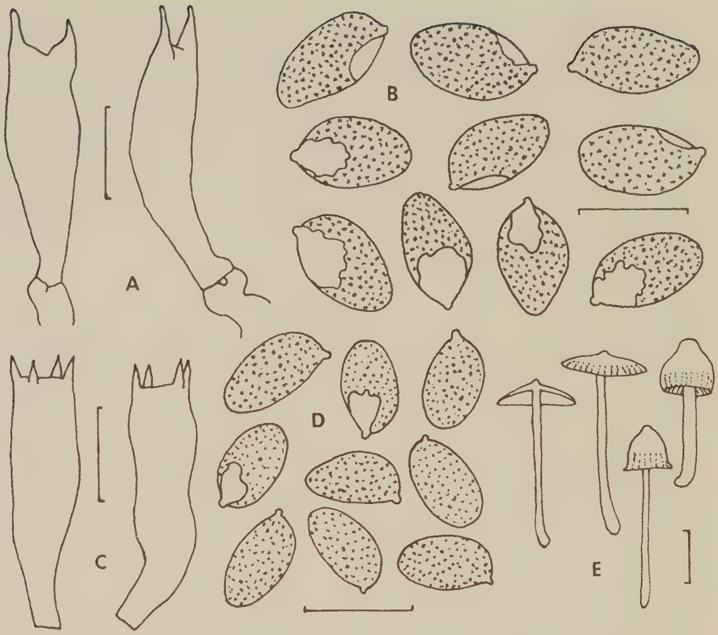

Fig 1. *Galerina nana*. - A. Bi-sporic basidia. - B. Basidiospores from bi-sporic basidia. - C. Tetra-sporic basidia. - D. Basidiospores from tetra-sporic basidia. - E. Habit. Bars (A - D) = 10 µm. Bar (E) = 1 cm.

PILEUS up to 22 mm diam., and to 8 mm high, ovate-conical becoming convex to broadly convex or campanulate, approaching plane with age, mamillate or occasionally obscurely umbonate, margin incurved then decurved, undulating with age, translucent-striate, hygrophanous, smooth, moist, mostly yellow-brown, (6D8[1]; 5YR 4/4[2], 7.5YR 4/6), centrally dark reddish-brown (5YR 3/3), paler yellow between the striae (7.5YR 6/8), yellow when dry (5B4; 10YR 8/6). PARTIAL VEIL a cortina of white fibrils present on very immature specimens, with older specimens showing remnants around the margin, quickly disappearing with age. LAMELLAE adnate or adnate with a small decurrent tooth, ascending to horizontal, subdistant, generally with two series of lamellulae, to 3 mm deep, thin, sides pruinose, edges minutely denticulate, brownish-yellow (5C67; 10YR 6/6). STIPE 19 - 45 mm long, 1 - 3 mm diam.,

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[1] Colours recorded from Kornerup, A. & Wanscher, J.H. (1981). Methuen Handbook of Colour, 3rd edn. Eyre Methuen, London.

[2] Colours recorded from Munsell Soil Colour Charts, Baltimore (1975).

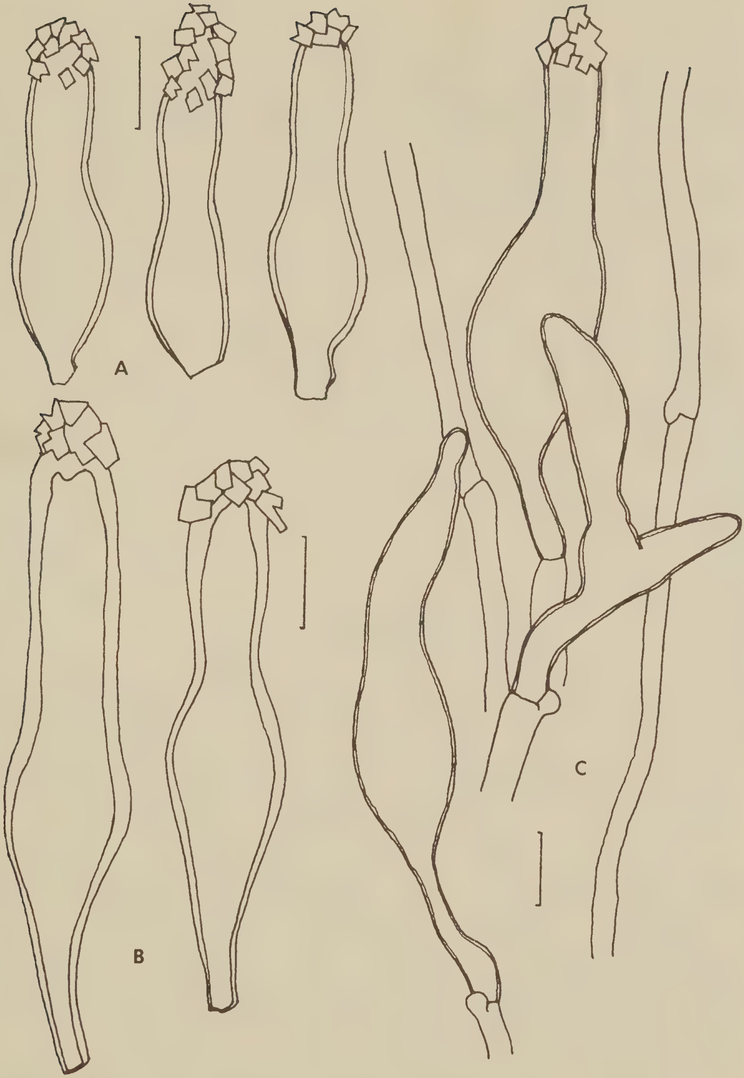

Fig. 2. Galerina nana. - A. Cheilocystidia. - B. Pleurocystidia. - C. Cystidia from partial veil. Bars = 10 µm.

cylindric above, base sub-bulbous, apex pruinose, the remainder sparsely longitudinally white fibrillose, partial veil zone obscure, fistulose, yellow at apex, red-brown below, to black basally, basal mycelium white tomentose.

ODOUR not distinctive. SPORE PRINT rich rust-colour (7.5YR 4/6).

BASIDIOSPORES [88/4][3], 8.5 - 12.4 ($\bar{x}$ = 10.6) x 4.9 - 7.2 ($\bar{x}$ = 6.2) µm, L/B[4] = 1.7 from predominantly two-spored collections and [51/4], 7.3 - 9.8 (- 11.0) ($\bar{x}$ = 8.6) x 4.9 - 6.1 (- 6.7) ($\bar{x}$ = 5.2) µm, L/B = 1.7 from predominantly four-spored collections, ovate-amygdaliform or amygdaliform, verrucose, suprahilar plage present, thick-walled, brown in 10% NH_4OH. BASIDIA [29/2], 24.5 - 32.0 ($\bar{x}$ = 28.3) x 6.4 - 8.8 ($\bar{x}$ = 7.2) µm, with sterigmata up to 9.6 µm long, either predominantly two- or four-spored within a collection, clavate. CHEILOCYSTIDIA [42/3], 34.4 - 71.2 ($\bar{x}$ = 48.4) x 8.5 - 13.7 ($\bar{x}$ = 11.5) µm, metuloid, fusoid-ventricose, pedicellate, apices generally heavily encrusted with crystals, thick-walled, walls up to 1.8 µm thick, pale yellowish in 5% KOH. PLEUROCYSTIDIA [53/4], 43.9 - 73.2 ($\bar{x}$ = 58.6) x 9.5 - 18.3 ($\bar{x}$ = 13.3) µm, similar to cheilocystidia. CAULOCYSTIDIA [11/1], 58.0 - 108.0 ($\bar{x}$ = 76.6) x 8.0 - 14.4 ($\bar{x}$ = 11.9) µm, similar to hymenial cystidia. HYMENOPHORAL TRAMA subregular, hyphae 2.5 - 15.0 µm diam., with encrusting pigment. PILEAL SURFACE an epicutis of filamentous, more or less gelatinized hyphae, 2.5 - 6.0 µm diam., hyphae of hypodermium broader, with golden-brown encrusting pigment. PARTIAL VEIL consisting of filamentous, occasionally encrusted hyphae, 2.0 - 4.8 µm diam., terminal cells often differentiated into cystidia similar to those in the hymenium. CLAMP CONNECTIONS present in all tissues.

HABIT, HABITAT and PHENOLOGY:- gregarious, on the ground or on wood fragments, preferring poorly drained sites, in woodland or forest under *Eucalyptus* (*E. ovata* Labill., *E. obliqua* L'Hérit, *E. radiata* Sieber ex DC., *E. sieberi* L.A.S. Johnson, *E. regnans* F. Muell.) or *Leptospermum phylicoides* (A. Cunn. ex Schauer)Cheel, often occurring in recently burnt areas, and then amongst *Marchantia* and *Funaria*; fruiting throughout the year, mostly from April to May.

MATERIAL:- SOUTH AUSTRALIA: Mt Lofty Botanic Garden, below "Carmino", 9.v.1984, AD 9936, C.A. Grgurinovic & R.J. Chinnock. VICTORIA: Courtney's Road Reserve, Belgrave, ix.1983, AD 12170, T.W. May M423; 6.xi.1983, AD 12169, T.W. M. M461; 15.v.1984, AD 12168, T.W. M. B155. Sherbrooke Falls, 20.i.1985, AD 12167, T.W. M. B188. Yalmy Rd, East Gippsland, iv.1984, AD 11804, T.W. M. B146. Anglesea, ix.1983, AD 11948, B.A. Fuhrer & T.W. M. B83. Old Lilydale-Healesville Railway, 18.v.1985, AD 12166, T.W. M. B338.

Galerina nana is readily recognised by its encrusted metuloidal cystidia and its verrucose spores which possess a plage. It can be distinguished macroscopically by the small size of the basidiomata, the mamillate pileus and the

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[3] [88/4], 88 measurements from 4 collections (see Bas, 1969:290).

[4] L/B, length-breadth ratio.

ERRATA, VOLUME THIRTY-ONE

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exannulate stipe.

Basidiomata of G. nana are frequently found after fire in Australia, where they occur with typical post-fire species such as Coprinus angulatus Peck, Gerronema postii (Fr.)Sing., Pholiota carbonaria A.H. Smith and Polyporus mylittae Cooke & Massee. However, the species has not been recorded as occurring after fire elsewhere and its basidiomata have also been collected in unburnt sites in south-eastern Australia. This fruiting of G. nana after fire may be due to an ability to grow in disturbed areas, such as on bare ground, as much as any specific physical or chemical changes in the environment caused by fire.

Both bi-sporic and tetra-sporic races have been found in Australia. There does not appear to be any difference between races in distribution, habitat, or time of fruiting. Both races occurred with equal frequency on burnt and unburnt sites. At one locality both of these races were collected at different times of the year.

The addition of Australia to the range of G. nana raises the question of the geographic origin of the species. Galerina nana has been found in both the northern and southern hemispheres, but is regarded as an exotic in Europe and North America. Petri (1904) suggested that the type collection (from the Florence Botanic Garden) had been introduced with exotic plants. Smith & Singer (1964) considered, that although widely distributed in Europe and North America, G. nana was uncommon in, and not native to these areas. Horak (1983) also recorded G. nana from Europe as growing in artificial habitats, with only rare occurrences in natural forests.

Horak (1983) listed G. nana as having a circum-pacific distribution (New Zealand - South America). However, the natural distribution has been recorded as extending to Central America (Smith & Singer, 1964), Africa (Pegler, 1977) and India (Natarajan & Raman, 1983) and the species has now been found in native Eucalyptus forests in Australia. New Zealand, South America, Africa, India and Australia originated from the fragmentation of Gondwana. A number of fungal species have a distribution pattern which can be explained by a Gondwanan origin. This is especially so for mycorrhizal agarics associated with Nothofagus Blume, which is itself of Gondwanan origin (Horak, 1983; Watling, 1985; White, 1986). The natural distribution of G. nana can also be interpreted as a result of its occurrence in Gondwana prior to the formation of the southern continents.

Some fungal species or genera of Gondwanan origin have extended their range to the northern hemisphere - most species of Rozites Karst. are found in the southern hemisphere, with one species known from Europe and one from India (Horak, 1983) and Panellus longinquus (Berk.)Sing. is found in South America, New Zealand and Australia, but also has a subspecies occuring in North America (Libonati-Barnes &

Redhead, 1984). Similarly, the presence of G. nana in the Caribbean (Jamaica) may have resulted from migration from South America. It is possible that the other northern hemisphere occurrences of G. nana are also the result of range extension by migration rather than introduction. However, rarity of the species and its frequent occurrence in greenhouses and gardens (Singer & Smith, 1964), suggests introduction rather than migration.

ACKNOWLEDGEMENTS

The authors would like to thank the Department of Conservation, Forests and Lands, Victoria for permission to collect in areas under its control, Mr B.A. Fuhrer for providing collections of Galerina nana, Miss T. Eadsforth for typing the manuscript and Dr R. Watling for reviewing the manuscript.

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MYCOTAXON

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LOST AND FOUND: A DISCOMYCETE PILGRIMAGE

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Two European species referable to the genus *Strossmayeria* Schulzer and one referable to the genus *Unguiculariopsis* Höhnel were believed to be "lost," because their type specimens were presumed no longer in existence. In September, 1987, a two-week collecting trip by the three of us was undertaken to search for holotypes, and, failing that, to recollect the fungi in their type localities to allow for the designation of topotypic neotypes for these names.

LECANIDION ALBUM CROUAN & CROUAN, A *STROSSMAYERIA*

Our first journey was to Concarneau, in the province of Finistère (Brittany), where the Crouan brothers' herbarium is located at the Laboratoire de Biologie Marine du Collège de France. An earlier visit in 1983 to this herbarium by the senior author, specifically searching for the type specimen of *Lecanidion album* Crouan & Crouan (**1867**), had met with no success (Iturriaga, **1984**). The herbarium is housed without much order in many boxes, drawers, and cabinets in the laboratory's library, and we felt it was still possible that the type specimen may have been misfiled or overlooked on that first visit. We were joined in our search by our colleague, Mme. Françoise Candoussau, of Pau, France (a Cooperating Scientist of the Cornell Plant Pathology Herbarium). Through the kindness of M. Yves Le Gal, the Sous-Directeur of the laboratory, we were afforded the chance to go through the complete herbarium at our leisure. To our delight, after but a few hours of searching, the holotype specimen of this species was discovered in a drawer in which the senior author had failed to look during his first visit to Concarneau. One of us (T.I.) has now examined that holotype specimen, and confirms that it is a species of *Strossmayeria,* as had been presumed. Moreover, we found an annotation slip within the packet, filed by Steven Carpenter, indicating that he had seen the specimen on a visit to Concarneau in 1979, and that in his opinion this provides an older epithet for *S. basitricha* Sacc. At this time the one of us working on *Strossmayeria,* (T.I.), has not concluded that that synonymy is necessarily correct.

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PITHYELLA HAMATA CHENANTAIS, AN *UNGUICULARIOPSIS*

We had been informed by Mme. Baudouin, Conservateur du Muséum d'Histoire Naturelle, Nantes, France, that the discomycete portion of the herbarium of the late J.-E. Chenantais had apparently been destroyed during World War II, and that only the pyrenomycetes have survived and are deposited in that herbarium (NM). We determined, nevertheless, to search through the Chenantais herbarium, since the fungus we sought occurs upon the hysterothecia of a "pyrenomycete," *Rhytidhysteron hysterinum.* We thus journeyed to Nantes, where we were able to examine the entire contents of four boxes of pyrenomycetes, all that remains of the Chenantais herbarium. We did discover one packet of the host "pyrenomycete," collected apparently at the same time as was the collection upon which *Pithyella hamata* Chenantais (**1918**) had been described, but unfortunately, no apothecia of the fungicolous discomycete were found. Within the boxes we did discover Chenantais's accession book for discomycetes and myxomycetes, and found an entry for a new species of *Pithyella* that he collected in 1907 that is unquestionably the data for the species he described in 1918 as *P. hamata.*

Our colleage, Françoise Candoussau, had earlier also corresponded for us in our search for the type specimen of this species, and had discovered that originally the Chenantais herbarium had been under the care of Dr. Maurice Chassain, of St.-Julien-de-Concelles. We were able, then, to visit with Dr. Chassain in his home, where he showed us portions of his vast collection of many thousand colored transparencies and SEM photographs of myxomycetes, and a copy of his book illustrating a few of these (Chassain, **1979**). He confirmed what he had already written to Mme. Candoussau earlier, that he had been responsible for giving the pyrenomycete portion of Chenantais's herbarium to the museum in Nantes. There had also been one box containing myxomycete and discomycete specimens that he had simply discarded as "useless" for study. He did retain an index volume from the Chenantais herbarium, listing all the collections. When we pointedly asked him about voucher specimens for the many beautiful colored and SEM photographs he published in his book, and for the thousands of unpublished ones, he indicated that he did not believe in keeping specimens of myxomycetes, as they "preserve poorly." We had, thus, no choice but to try to find a neotype to replace the discarded holotype of Chenantais's species.

We had earlier contacted the Office de Tourisme in Ruffec, in the province of Charente, where Chenantais had collected his species at a site called La Roche, and had been sent a detailed map showing this spot. Similarly Mme. Candoussau had contacted her old friend, Dr. Etienne Chollet, a doctor of veterinary medicine and botanist of Ruffec, who knew the area well. He sent her detailed directions and maps not only to La Roche, a farm belonging to old clients of his, but to other localities in the Ruffec area where he knew the higher plant, *Buxus sempervirens,* grows [on which the *Rhytidhysteron* and the fungicolous *"Pithyella" (Unguiculariopsis)* occur]. The four of us proceeded to examine the only remaining stands of boxwood at La Roche, but even though we did discover the *Rhytidhysteron,* no trace of the *Unguiculariopsis* was found in this exceptionally dry location. The following day, however, a few kilometers to the north, following Dr. Chollet's directions, we obtained an ample collection of Chenantais's species in a boxwood thicket near a stream, in a much moister locality, and this collection will serve as a neotype for his species name. It is planned to divide the neotype collection and to distribute it in the exsiccati set, Discomycetes Exsiccati. The one of us now working on a monograph of *Unguiculariopsis,* (W.-y. Z.), currently considers this a taxon valid at the subspecific level.

PEZIZA HETEROMORPHA SCHULZER, A *STROSSMAYERIA*

Our next journey was to Yugoslavia, to attempt to find a neotype for the fungus that Schulzer had twice described as new from the same specimen, once as *Peziza heteromorpha* Schulzer (**1878**) and later as a new genus (and species!), *Strossmayeria rackii* Schulzer (**1881**). These are obligate synonyms, and both names are typified by a specimen believed to be lost (Iturriaga, **1984**). Since the authority on Schulzer's manuscripts and few known specimens is Dr. Milica Tortić (**1970**), now retired from the University of Zagreb, the authors stopped there to see the Schulzer manuscript, and to talk with her. She confirmed that there are only a few Schulzer specimens known, mostly of polypores, and that the Schulzer herbarium has not survived. Schulzer had described the fungus "im Walde Vidor bei Vinkovce" and "in silva Vidor prope Vinkovce," and had collected it in August and September. The senior author had enlisted the aid of Dr. Tortić and of two former Cornellians from Yugoslavia, Dr. Jelena Lević and Mr. Ivan Buturac, to find out if there was still a Vidor Forest near 'Vinkovce' (Vinkovci). Through their concerted efforts we were placed in contact with the forestry personnel responsible for the Vinkovci area. While there is no area known locally as "Vidor Forest," there is a Vidor Creek within a few kilometers of Vinkovci, and this is part of a managed forest system. Our efforts to find the Schulzer species in the woods near Vidor Creek were rewarded beyond our highest hopes: we obtained nearly 40 separate collections of the species in two days of collecting, mainly in *Fraxinus* groves. The great majority of the collections are on wood of *Fraxinus,* the original substrate, and also bear the *Pseudospiropes* anamorph. Two of these are large enough collections to divide and issue in Discomycetes Exsiccati. One will serve as the neotype of Schulzer's species name(s).

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Without the cooperation of a large number of individuals, these studies would have been impossible. Foremost among these we must acknowledge the enthusiastic help and logistical support offered by our friend and colleague, Françoise Candoussau, of Pau, France, who accompanied us on our collecting trips in France, provided her personal auto for our use, and made many important contacts for us. She also served as presubmission reviewer of this paper. To the directors and curators at Concarneau (Dr. Yves Le Gal) and at Nantes (Mme. Baudouin and Mlle. Cuenca), to Dr. Maurice Chassain at St.-Julien-de-Concelles, to Dr. Etienne Chollet at Ruffec, to the Director of the Office de Tourisme at Ruffec, to Dr. Milica Tortić at Zagreb, to Mr. Dražen Budiša of the University Library at Zagreb, to Dr. Jelena Lević at Beograd, to Mr. Ivan Buturac at Delnice, and to Messrs. Boro Jureša and Nikola Segedi of the Forestry station "Hrast" Vinkovci, we express our deepest thanks.The financial support of the College of Agriculture and Life Sciences at Cornell University in the form of a Travel Award to the senior author is also aknowledged. Both the second and third authors received a major travel grant from the Cornell University Center for International Studies. Support from the Anna E. Jenkins Bequest to the Department of Plant Pathology was provided for the remaining travel costs of the expedition.

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A COMPUTER PROGRAM FOR THE RAPID IDENTIFICATION OF LICHEN SUBSTANCES

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ABSTRACT: A computer program for the identification of lichen substances based on thin layer chromatographic R_F values, the colour of the developed t.l.c. spots under visible and ultraviolet light, as well as the results of lichen spot test results is described. The program accepts R_F data from six standard solvent systems and a range of possible colours. A list of possible answers is generated within a user defined error range of both colours and R_F values. The program is designed for an Apple Macintosh computer with a 512K memory and is quick and very easy to use.

Introduction

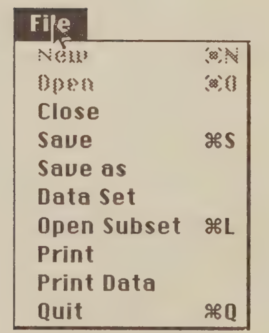
The application of chemical discriminators to lichen taxonomy began inadvertently when thalline colour was accepted as a valid generic or specific character. Hence the grey genus *Physcia* (containing the colourless substance atranorin in the cortex) was segregated from the superficially similar yellow-orange genus *Xanthoria* (containing cortical parietin, an orange anthraquinone pigment). Similarly *Parmeliopsis ambigua* (Wulfen.) Nyl. (with a yellow thallus due to the presence of usnic acid) was separated from *P. hyperopta* (Ach.) Arn. (grey with atranorin). Nevertheless most lichen substances are colourless and can be detected only by indirect means. The first chemical tests conducted on lichen thalli for taxonomic purposes were carried out by Nylander in the 1860s (Nylander 1866). He detected the presence of various lichen substances by spotting chemical reagents directly on the lichen thallus (spot tests) to produce characteristic colour changes: iodine solution (I; blue with certain polysaccharides), potassium hydroxide solution (K; distinctive colours with quinones, some depsides and depsidones) and calcium hypochlorite solution (C; pink or red with some depsides). Further test reagents followed; KC (K solution followed by C) and CK (with reverse addition). Nylander utilised the characteristic medullary and cortical reactions as a specific character, but the origin of these characteristic colour reactions remained unknown. The first serious chemical investigations were conducted by Zopf, culminating in his publication of 'Die Flechtenstoffe' in 1907 (Zopf 1907) with the description of over 150 lichen compounds. However the ultimate structural elucidation of many common lichen metabolites was due to the meticulous pioneering work of Asahina and co-workers in Japan in the 1930s (see Asahina & Shibata 1954). This laid the foundation for futher research on the compounds in recent times. Asahina also developed an additional spot test reagent (Pd, *p*-phenylenediamine solution) and a microcrystallization technique for more definitive recognition of individual lichen acids.

Subsequently the techniques of paper chromatography and particularly thin layer chromatography (TLC) have vastly improved the speed and certainty of recognition of lichen substances by means which are simple to use and relatively inexpensive. Standardised methodology and further refinements of analytical TLC procedures for detecting and comparing lichen metabolites have been reported by C.F. Culberson and colleagues (Culberson 1972; Culberson & Ammann, 1979; Culberson, Culberson & Johnson 1981; Culberson & Johnson 1982). Further, two dimensional TLC has considerably improved R_F discrimination of structurally similar compounds and has enabled the identification of minor constituents present in complex mixtures (Culberson & Johnson 1976). More recently still, high performance liquid chromatography (HPLC) also has been employed as an effective analytical tool for the separation and identification of lichen substances. A added advantage of this technique is that it yields quantitative information about the components present in the total lichen extracts. At present a disadvantage of the HPLC system is the expense of the equipment and purified solvents, making it beyond the reach of more modest institutions and routine chemotaxonomic investigations. Consequently TLC remains the most readily accessible and widely used method for identifying lichen metabolites routinely. As chemical investigations now form an integral part of all serious taxonomic studies on lichen-forming fungi, inevitably even the more experienced lichenologist encounters TLC spots that are unfamiliar and difficult to identify.

In an effort to make the bulk of literature information on standardised TLC R_F values and spot colour characteristics more readily accessible, and to keep such a library of information current as more and more lichen metabolites are identified and characterised, we have prepared a data bank suitable for storing such information. The data is manipulated on the computer by a search program which operates on experimentally observed R_F values and TLC spot characteristics to search the data bank and generate a list of possible identities for the observed spot. The program provides powerful editing and reporting features. A standard set of colours is provided in an effort to reduce the differences in colour interpretation. Both the colour and R_F error of the unknown spot can be changed at will, as can the data stored in the data bank upon which the search is conducted. Furthermore additional information can be incorporated readily into the data set by the operator. The program is menu driven and Figure 1 shows the programs menu options.

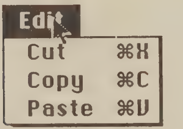
Figure 1. The Menu Options available in the Program

The File Menu

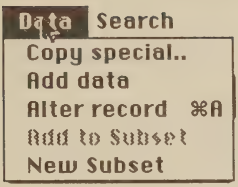


- The New option is used to enter new input data.
- Open is used to recall saved input data from disk.
- Close is used to clear input data.
- Save and Save as allow the storage of input data on disk.
- Data Set allows the user to generate entirely new and different data files (subsets).
- Open Subset retrieves a data file from the disk in order to conduct a subset search.
- The Print option prints the current input data or answer set depending on which is active.
- Print Data outputs the the current data set or subset.
- Quit exits the program.

The Edit Menu

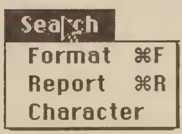


- Cut
- Copy Macintosh Clipboard functions.
- Paste



The Data Menu

- Copy special enables the user to transfer input data or answers from a search to other Macintosh programs.
- Add data allows the user to extend the data base.
- Alter record allows the user to edit the data base.
- Add to subset adds records to the current subset.
- New Subset allows the user to create and save a subset of the data base.



The Search Menu

- Format allows the user to change the search parameters.
- Report generates the answer set from the input data.
- Character allows the user to enter the spot test data (i.e. K, C, KC or Pd) for the lichen that contains the unknown(s) being searched.

The Data Set

The data set operates primarily on R_F values obtained by TLC on silica gel in any number of six standard solvent systems (A, B, B', C, E, G); the characteristics of the TLC spot, i.e. whether the spot is coloured in visible (natural) light or visible under short wavelength ultraviolet light; the colour of the spot in visible and long wavelength ultraviolet light after spraying with 10% sulfuric acid and charring; or the colour after spraying with Archer's solution (Archer 1978). Information from simple thalline spot tests can also be incorporated and analysed to assist in the identification of the compounds. Mass spectrometric data also can be used if available. Often the presence of a particular metabolite may be inferred from the co-occurrence of a closely related biosequential or accessory metabolites found in the same lichen. Biosequentially related compounds are listed for each entry. However it is not necessary to have all such information about an unknown spot - the search program will operate on as little information as a single R_F value. Qualifying information simply reduces the number of possible answers generated.

Listed along with the name of each lichen substance is the following information (where available):

1) The Rf values of the compound in six standard solvent systems:

A, toluene/ dioxane/ acetic acid (180 : 45 : 5)

B, hexane/ diethyl ether/ formic acid (130 : 80 : 20)

B', hexane/ methyl *tert*-butlyl ether/ formic acid (140 : 72 : 18)

C, toluene/ acetic acid (170 : 30)

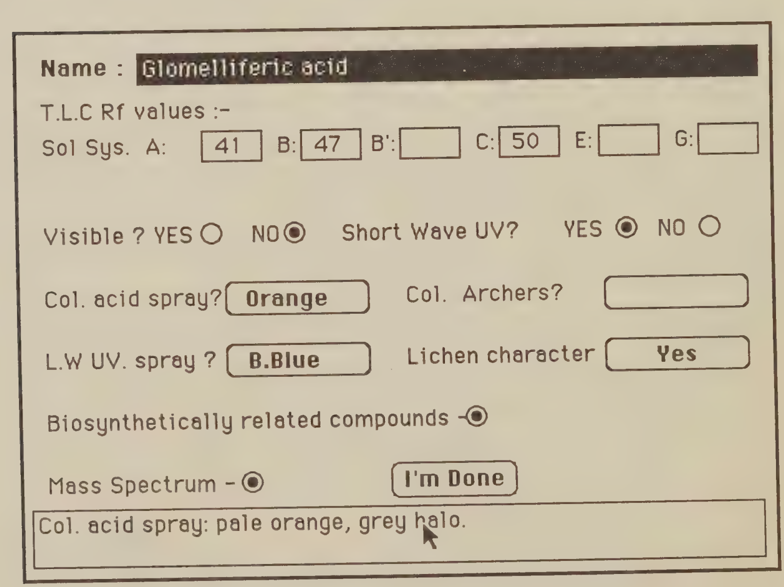
E, hexane/ ethyl acetate (75 : 25)

G, toluene/ ethyl acetate/ formic acid (139 : 83 : 8).

2) Whether the TLC spot is coloured in visible (natural) light or visible under short wavelength ultraviolet light.
3) The colour of the TLC spot in visible (natural) and long wavelength ultraviolet light after spraying with H_2SO_4 and charring
4) The colour of the TLC spot after spraying with Archer's solution
5) The results of thalline spot tests with K, C, KC, Pd
6) Four major peaks in the mass spectrum
7) Up to ten biosynthetically related compounds
8) Notes, a one hundred long character message containing additional information regarding the charcateristics of the particular substance, individual tests, confirmatory tests for distinguishing closely related compounds with which it might be confused, etc.

The data set can be expanded or edited with the program using the Add data or Alter record options. Figure 2 shows the screen display when altering a record. Adding a record displays the same screen except the user is given the option to continue adding records.

Figure 2. The Screen Display when Altering an Entry in the Data Base.



Name : Glomelliferic acid

T.L.C Rf values :-

Sol Sys. A: 41 B: 47 B': C: 50 E: G:

Visible ? YES ○ NO ● Short Wave UV? YES ● NO ○

Col. acid spray? Orange Col. Archers?

L.W UV. spray ? B.Blue Lichen character Yes

Biosynthetically related compounds -●

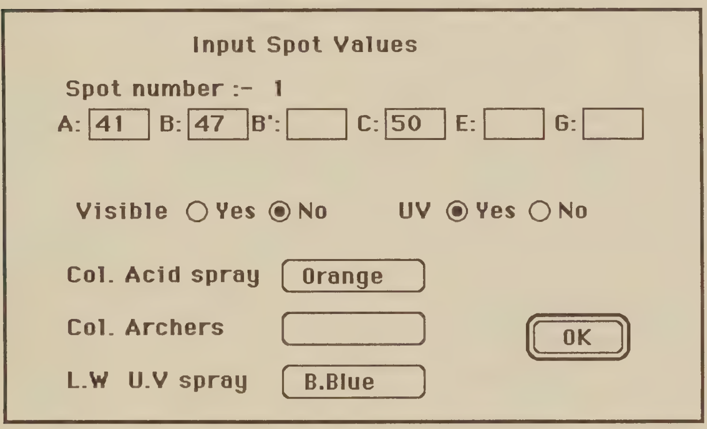
Mass Spectrum - ●

Col. acid spray: pale orange, grey halo.

Searching the Data Base

The program requires at least one R_F value to conduct a search (Figure 3 shows the input screen). A subset of the total data set is generated from the first R_F value. Additional information such as another R_F value for the same spot in a different solvent system, or the colour after spraying with sulfuric acid is used to eliminate unlikely entries from this subset. The searching algorithm uses all the information stored in the data set except the biosynthetically related compounds, the mass spectral data, and the notes. A search is conducted by first entering the data for the unknown substance (see Figure 3) and then selecting Report from the Search Menu. The R_F error, colour errors and the input data that is used in the search is controlled by selecting Format (Figure 4) from the Search Menu. The input values for the unknown can be stored on disc for recall at a later time (Save or Save as options from the File Menu).

Figure 3. The Input Screen Display



Input Spot Values

Spot number :- 1

A: 41 B: 47 B': C: 50 E: G:

Visible ○ Yes ● No UV ● Yes ○ No

Col. Acid spray Orange

Col. Archers

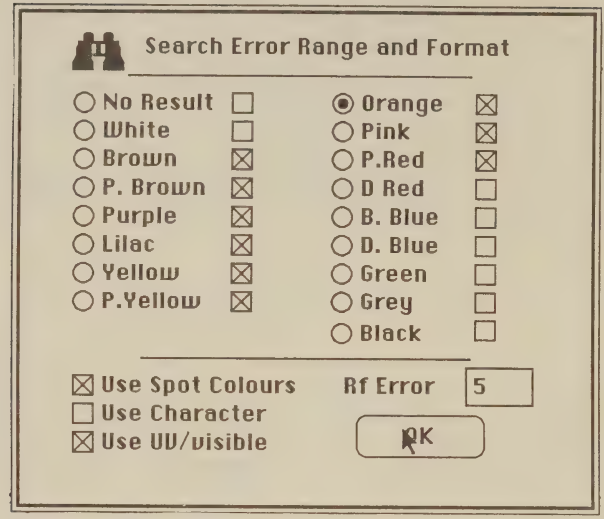
L.W U.V spray B.Blue

Often a particular lichen genus being studied may contain a much more limited number of compounds. In such cases a subset of the data set can be generated to allow more rapid and specific searching.

The Output

After selecting Report from the Search Menu all the possible answers are displayed below the input (experimentally observed) values for the spot. In addition, for each answer the accepted R_F values and the spot colours are displayed on the screen (Figure 5). The user can then select to display the notes, the mass spectral data or the biosynthetically related compounds for each of the answers generated. Furthermore the program can print the answers generated, the input values or the entire data set.

Figure 4. Format of Search; Screen Display



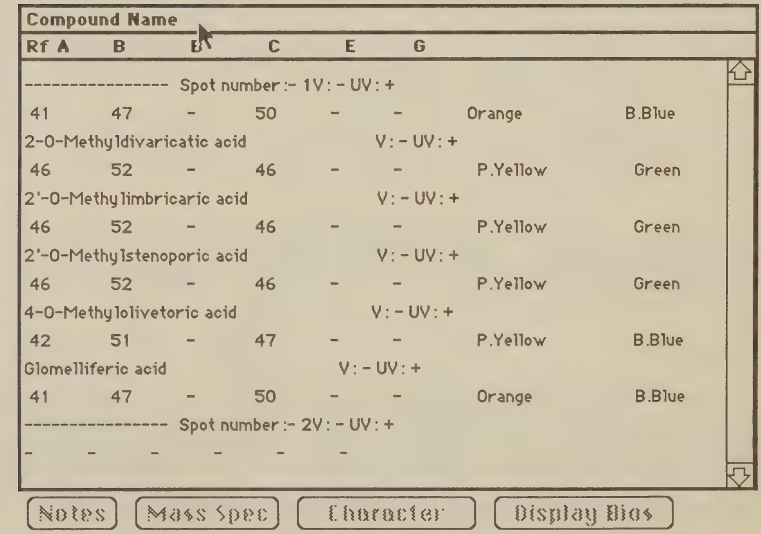
Search Error Range and Format

○ No Result	☐	● Orange	☒
○ White	☐	○ Pink	☒
○ Brown	☒	○ P.Red	☒
○ P. Brown	☒	○ D Red	☐
○ Purple	☒	○ B. Blue	☐
○ Lilac	☒	○ D. Blue	☐
○ Yellow	☒	○ Green	☐
○ P.Yellow	☒	○ Grey	☐
		○ Black	☐

☒ Use Spot Colours
☐ Use Character
☒ Use UV/visible

Rf Error 5

Figure 5. Report of Search; Screen Display



```
Compound Name
Rf A      B       E       C       E       G
---------------- Spot number :- 1V : - UV : +
 41       47      -       50      -       -       Orange          B.Blue
2-O-Methyldivaricatic acid                V : - UV : +
 46       52      -       46      -       -       P.Yellow        Green
2'-O-Methylimbricaric acid                V : - UV : +
 46       52      -       46      -       -       P.Yellow        Green
2'-O-Methylstenoporic acid                V : - UV : +
 46       52      -       46      -       -       P.Yellow        Green
4-O-Methylolivetoric acid                 V : - UV : +
 42       51      -       47      -       -       P.Yellow        B.Blue
Glomelliferic acid                    V : - UV : +
 41       47      -       50      -       -       Orange          B.Blue
---------------- Spot number :- 2V : - UV : +
-     -     -     -     -     -
```

Performance of the Program

An acetone extract of the lichen *Hypotrachyna immaculata* (Nyl.) Hale shows six major spots on TLC in solvent system C. The observed R_F values in the three solvent systems A, B and C and spot colours are shown in Table 1.

Table 1. TLC Data for Extract from *Hypotrachyna immaculata*

Spot No.	RF values			Visible	UV active	Colours	
	A	B	C			H_2SO_4	Spray+UV
1	15	36	10	+	+	green	green
2	25	35	18	-	+	orange	purple
3	32	35	31	-	+	green	green
4	37	43	40	-	+	grey	purple
5	40	73	42	-	+	brown	purple
6	75	78	79	-	+	orange	orange

Spot number 3 was chosen as a suitable example to demonstrate of the searching potential of the program. Table 2 shows the results in terms of the number of answers generated for a variety of search conditions. The data set currently contains 430 entries. Using this data set the program produces 124 possible compounds when a single R_F value is entered and the R_F error is set at 10 (i.e. ± 10%, giving an overall 20% range in error). This rather large number of answers is readily reduced to 70 by entering the visibility under natural and short wave ultraviolet light. The fact that spot 3 is not visible in natural light eliminates all pigments, but is visible under ultraviolet light eliminates all the terpenes and aliphatic acids.

Table 2. Data types versus the number of answers generated for a test compound

Input data	Number of Answers	Error(±%)
Rf C	124	10
Rf C, Vis, UV,	70	10
Rf C, Vis, UV, spot colours	8	10
Rf C, Vis, UV, spot colours	6	5
Rf C, Vis, UV, spot colours	3	3
Rf C, Rf A	53	10
Rf C, Rf A , Vis, UV,	43	10
Rf C, Rf B , Vis, UV, spot colours	4	10
Rf C, Rf A, Rf B, Vis, UV, spot colous	2	10
Rf C, Rf A , Vis, UV, spot colours	1	5

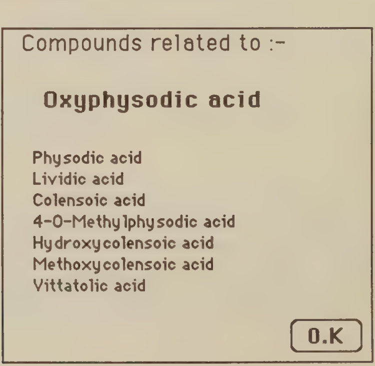
The number of answers is further reduced to 8 after entering the colours of the spot after spraying and charring (Table 3). Already an acceptable number of answers have been obtained with the data from just a single spot. If the R_F error is reduced to ±5% (i.e. R_F range of 26 - 36), an accuracy readily achieved by most workers, only 6 answers are found. When an the R_F value for this compound in a second solvent system is entered at this level of the search a unique answer is obtained, namely lividic acid.

Table 3. The Answer Set Generated With One R_F Value and ±10% Error

		R_F's					Colours	
A	B	B'	C	E	G	H_2SO_4	Archers	Char-UV
--Spot number		**1**						
-1	-1	-1	31	-1	-1	Green		Purple
Norlobaridone								
50	36	36	21	-1	-1	Green	Lilac	B.Blue
Normiriquidic acid								
31	-1	41	21	-1	-1	B.Blue		P.Yellow
Lividic acid								
32	35	37	31	-1	-1	Green		Purple
Conloxodin								
50	36	31	32	-1	-1	Green		B.Blue
Loxodin								
58	40	40	35	-1	-1	Green		B.Blue
Methyl 3-α-hydroxy-4-O-methylbarbatate								
43	36	-1	35	-1	-1	Yellow		Green
α-Collatolic acid								
40	32	35	35	-1	-1	P.Yellow		D.Blue
Picrolichenic acid								
38	39	45	36	-1	-1	P.Yellow		Purple

Table 4 illustrates the answer set generated when all the data from Table 1 is used. Although unique answers are generated for spots number 1, 2, 3 and 5, three possible answers were generated for spot number 4, namely picrolichenic acid, 4-O-methylphysodic acid and baeomycesic acid. Baeomycesic acid and picrolichenic acid can be eliminated on spot colours (although this is best done only after co-chromatography with authentic materials) as well as on biosynthetic grounds. Thus the compounds biosynthetically related to oxyphysodic acid include physodic acid, lividic acid, colensoic acid, 4-O-methylphysodic acid, vittatolic acid, hydroxycolensoic acid and methoxycolensoic acid (as indicated by the program in Figure 6). Since other co-occurring compounds present in *Hypotrachyna immaculata* have already been identified as physodic acid, lividic acid and colensoic acid - compounds which are known to be biosynthetically related to oxyphysodic acid - it seems most probable that spot 4 is due to 4-O-methylphysodic acid. As lividic acid and its cogenors are relatively common in the genus *Hypotrachyna* they could be incorporated in a subset to be searched when determining further unknowns in specimens of this genus.

Figure 6. Compounds Biosequentially Related to Oxyphysodic Acid; Screen Display



Compounds related to :-

Oxyphysodic acid

Physodic acid
Lividic acid
Colensoic acid
4-O-Methylphysodic acid
Hydroxycolensoic acid
Methoxycolensoic acid
Vittatolic acid

Table 4. The Answer Set Generated with the Data in Table 1, and an Error ±5%

		R_F's					Colours	
A	B	B'	C	E	G	H_2SO_4	Archers	Char-UV
---- Spot number 1								
15	36	-1	10	-1	-1	Green		Purple
Oxyphysodic acid								
15	36	-1	10	-1	-1	Green		Purple
---- Spot number 2								
25	35	-1	18	-1	-1	Orange		Purple
Physodic acid								
25	35	35	18	-1	-1	Orange		Purple
---- Spot number 3								
32	35	-1	31	-1	-1	Green		Purple
Lividic acid								
32	35	37	31	-1	-1	Green		Purple
---- Spot number 4								
37	43	-1	40	-1	-1	Grey		Purple
Picrolichenic acid								
38	39	45	36	-1	-1	P.Yellow		Purple
4-O-methylphysodic acid								
37	43	45	40	-1	-1	Grey		Purple
Baeomycesic acid								
39	40	41	42	-1	-1	Grey		Orange
---- Spot number 5								
40	73	-1	42	-1	-1	Brown		Purple
Colensoic acid								
40	73	68	42	-1	-1	Orange		Purple
--- Spot number 6								
75	78	-1	79	-1	-1	Orange		Orange
Dechloropannarin								
76	73	-1	75	55	-1	Orange		Orange
Atranorin								
75	78	73	79	57	-1	Orange	Orange	Orange
Chloroatranorin								
76	79	-1	80	26	-1	Orange	Orange	Orange

Indeed a real advantage of the program stems from the ease of establishing and utilizing subsets of data, since the overall search efficiency and the probability of generating unique answers can be considerably improved by subset searching. In the particular example above, a subset containing all compounds reported to occur in the genus *Hypotrachyna* can readily be constructed. When a search is conducted on this subset, unique answers are obtained for spots 1 to 5 with fewer input R_F values and less qualifying colour data.

Conclusion

We have developed a computer program which allows the rapid identification of lichen metabolites based on TLC R_F and other data. The program allows the user to search a large data base of information for over 400 lichen substances. Other information such as a list of biosynthetically related compounds can be used to eliminate unlikely answers. As an illustration the metabolites found to occur in the lichen *Hypotrochyna immaculata* are identified using the program. The program is used routinely in the identification of lichen metabolites in our laboratory and more importantly ,it will provide lichenologists with the ability to rapidly and readily identify metabolites for taxonomic and phytochemical studies. The program is uniquely easy to use.

Appendix A. Program Details

The program was written for an Apple Macintosh Computer (512K). The data set is stored as large random access file. A double inversion of data is used to give the program speed in the generation of answer sets. The record numbers in the data set are stored in six arrays (collectively known as the index file), there being a separate array for each solvent system. The arrays are indexed by the R_F value of the compounds, the elements of the arrays each contain a list of all the record numbers which have an R_F of that value for that solvent. Hence when a R_F value is input for searching the first answer set is generated by starting at the R_F - error index of the appropriate array for that solvent and then working up the array until the R_F + error index is reached. All the record numbers so obtained point to all the possible answers. When or if futher information is input the program then checks the subset generated from the first R_F value for consistency - any impossible answers are discarded. A subset of the data set is generated by simply by constructing a new index file.

A futher array stores the names of each compound, listed in alphabetical order, with the appropriate record number. This array is used to allow ready location of record names when it becomes necessary to alter a record or when entering further biosynthetically related compounds.

The program makes full use of the unique user friendliness of the Apple Macintosh Computer, fully supporting the windowing and menu environment. Very little typing is required to operate the program as most commands are issued with the Macintosh mouse (a graphic input device). Hence the program is very rapid and easy to operate.

A copy of the program and a users manual is available from the authors at a cost of $350.00 (US).

ACKNOWLEDGEMENTS

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GLYPHOPELTIS EBURINA AND XANTHOPSORELLA LLIMONAE ARE GLYPHOPELTIS LIGUSTICA, COMB. NOV.

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SUMMARY

The lichens **Glyphopeltis eburina** Brusse and **Xanthopsorella llimonae** Hertel et al. are reduced to synonymy with **G. ligustica** (B. de Lesd.) Timdal, comb. nov. (Lecideaceae). The species is reported as new to Macaronesia (Madeira).

The squamiform lichen **Psora ligustica** B. de Lesd. was described by Bouly de Lesdain (1935) from a single collection made by C. Sbarbaro in Liguria, Italy. This locality is still the only reported site for the species. Schneider (1980) placed it in **Lecidea** Ach., but gave no discussion of its affinities. Timdal (1984) found the species anatomically very similar to **Psora** Hoffm., but still excluded it from this genus because of the lack of anthraquinones and calcium oxalate in the apothecium, the green epithecium, the dark brown hypothecium, and the peltate squamules.

Later, Brusse (1985) described **Glyphopeltis** Brusse, a new monotypic genus with the new species **G. eburina** Brusse, from South Africa. When borrowing the holotype and one additional specimen from PRE, I found the species to be conspecific with **P. ligustica**.

Recently, Hertel et al. (in Nimis & Poelt 1987) described **Xanthopsorella llimonae** Hertel, Egea & Poelt from Spain and Sardinia. This is apparently the same species as **Psora llimonae** Hertel & Egea ined. mentioned by Llimona & Egea (1985: 438, 444). When borrowing an isotype from M, also this species turned out to be a later synonym of **P. ligustica**. **Xanthopsorella** Kalb & Hafellner (syn. **Xanthopsora** G. Schneider & W. Weber) is a North American, monotypic genus differing from **P. ligustica** mainly in having a different type of ascus, non-amyloid hymenial gelatine, different type of upper cortex, and containing anthraquinoid pigments in the thallus (Timdal 1984). **Psora ligustica** contains atranorin and usually bourgeanic acid (TLC); the report of no compounds by Timdal (1984) was probably due to insufficient extraction from the poor material then available.

Although **P. ligustica** is anatomically very similar to **Psora**, I still prefer to keep the species excluded from this genus and accept the genus **Glyphopeltis**.

GLYPHOPELTIS LIGUSTICA (B. de Lesd.) Timdal, **comb. nov.**

Psora ligustica B. de Lesd., Bull. Soc. bot. Fr. 82: 315 (1935). **Lecidea ligustica** (B. de Lesd.) G. Schneider, Biblioth. Lichenol. 13: 203 (1980, "1979"). - Type: Italy, Liguria orientalis, Framma, March 1935, Sbarbaro s.n. (LD, UPS; isotypes).

Glyphopeltis eburina Brusse, Lichenologist 17: 267 (1985). - Type: South Africa, Cape Province, 8 km NE of Granaatboskolk farmstead, alt. 910-1060 m, Brusse 1061 (PRE; holotype).

Xanthopsorella llimonae Hertel, Egea & Poelt in Nimis & Poelt, Stud. geobot. 7, Suppl. 1: 242 (1987). - Type: Spain, Prov. Murcia, Sierra de Enmedio, Puerto Lumbreras, alt. 500 m, Egea 628 (M; isotype).

The species is now known from Italy (Liguria and Sardinia), Spain (Granada, Murcia and Zaragoza), Portugal (Madeira), and South Africa (Bouly de Lesdain 1935, Brusse 1985, Nimis & Poelt 1987, and specimens cited below). The two localities I have examined in the field (Granada and Madeira) were both exposed, steep faces of rock where it grew together with **Peltula euploca** (Ach.) Pisut. Association with this lichen is also noted in Spain (Llimona & Egea 1985), Italy (Nimis & Poelt 1987), and on the label of one of the South African specimens examined (Brusse 4947, O).

Additional specimens examined: Spain, Granada, Sierra Nevada, near Valor, alt. 920 m, Hestmark & Timdal 5670 (O). **Portugal**, Madeira, Ribeira Brava, cliff E of the town, alt. 70 m, Krog & Timdal 5347 (O). **South Africa**, Cape Province, Vanrhynsdorp, 2 mi N of Nieuwe Rust, Almborn 4936 (LD); 10 km NE of Clanwilliam, Pakhuis Pass, alt. 550 m, Brusse 4947 (O); Orange Free State, Clarens, van der Plank 1898 (PRE).

Acknowledgements: Thanks are due to the curators of LD, M, PRE, and UPS for the loan of specimens, and to Prof. R. Santesson, Uppsala, for reviewing the manuscript.

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XYLARIA (SPHAERIALES, XYLARIACEAE) FROM CERRO DE LA NEBLINA, VENEZUELA

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ABSTRACT

A treatment of genus Xylaria from Cerro de la Neblina, Venezuela is presented here. Forty-one taxa are treated. The following new taxa are proposed: X. asperata sp. nov., X. griseo-olivacea sp. nov., X. kretzschmarioidea sp. nov., X. nodulosa var. microspora var. nov., X. platypoda var. microspora var. nov., and X. plumbea sp. nov. The following new combination is made: X. platypoda var. patouillardii comb. nov. Nine collections were not named owing to their small size or poor condition. Some of these undoubtedly represent new taxa. All taxa -- named and unnamed -- are included in keys and many are illustrated.

Cerro de la Neblina is an isolated mesa-capped mountain or tepui located on the border of Venezuela and Brazil. Owing to its unique ecosystem a series of multinational and multidisciplinary expeditions have been carried out there. Various aspects of the tepui and details of several expeditions were described by Jackson (1985). Collections used in this study were made by Samuels and Teresita Iturriaga in 1984 and Rossman in 1985. Collections were identified and, when possible, cultured by Rogers and Callan.

The primary objective of this paper is to allow the identification of *Xylaria* from this intensively investigated area. Additional objectives include increased understanding of the distribution and biology of *Xylaria* in general and of neotropical *Xylaria* in particular.

Xylaria is a taxonomically difficult genus which probably reaches the zenith of its complexity in the American tropics. Most of our knowledge of the genus has come from sporadic and fragmentary collections made by collectors interested primarily in other organisms. Fortunately, these collections have been deposited in the herbaria of the world. R. W. G. Dennis has made outstanding contributions to the cataloguing and identification of Venezuelan fungi, including *Xylaria* (1956, 1957, 1970). His publications are indispensable in identifying *Xylaria*. Other useful works include those of Rick (1935) and Theissen (1909) from Brazil. As would be expected, intensive collecting in the vicinity of Cerro de la Neblina has revealed both taxa that have been widely collected in the American tropics and taxa that have heretofore been undescribed. Dennis (1970) presented keys for 47 taxa of *Xylaria* from Venezuela and adjacent countries. About 18 of these taxa are represented in this paper and several others will be covered elsewhere as *Hypoxylon* or *Penzigia*. Nonetheless, roughly half of the taxa covered herein were not listed by Dennis. On the other hand, at least half of the taxa keyed out by Dennis are not represented in this paper. Our experience in other parts of South America is similar. Only additional intensive collecting and taxonomic studies will clarify the numbers of *Xylaria* taxa and their distributions based upon host, climatic, and other variables.

MATERIALS AND METHODS

Attempts were made to culture most of the fungi described herein. Comparatively few cultures were initiated owing to condition of specimens and probably also to ascospore germination requirements which were not met in our laboratory. In any case, all reported cultures were initiated from ascospores; cultural conditions and media are as reported in individual descriptions.

Holotype and other specimens were placed in VEN. Isotype and other material of Rossman were deposited at BPI. Isotype and other material of Samuels were deposited in NY. Material of Iturriaga was placed in VEN and some duplicates in NY. Portions of some collections that were further divisible were retained by JDR; these will ultimately be accessioned in WSP.

SPECIES WITH LARGE STROMATA ON WOOD
(Stromata usually 5 mm or greater in diameter)

1. Stromatal surfaces more or less smooth, usually tan, orange, white, or grey until blackening with extreme age 2
1. Stromatal surfaces more or less roughened with perithecial contours, coarse ostiolar papillae, warts, wrinkles, or all of the above, usually more or less black at maturity . . . 9

    2. Fertile part oblong-ellipsoidal, ca. 3 cm X 1 cm diameter, often with fringe of digitate conidial processes immediately below and/or above, blackish with white patches, on hirsute stipe 5 cm X 1 mm diameter. Ascospores 31-35 X 8-9 µm, with abrupt pinched ends and long spiralling germ slit . . . . . . *X. comosa*
    2. Combination of characters differing from above 3

3. Stromata usually subglobose, ca. 1.5 cm diameter, dull grey, on short stipe. Ascospores 23.5-29.5 X (6-)6.5-7.5 µm, with short straight or oblique germ slit . . . . *X. obovata*
3. Stromata usually clavate to cylindrical 4

    4. Fertile part clavate with short stipe, 3 cm X 1 cm diameter, copper-colored at first. Ostioles finely papillate. Ascospores 9 X 3.5-4.5 µm. . . . . . . *X. cubensis*
    4. Fertile part variously shaped. Ascospores much longer 5

5. Ascospores usually not longer than 25 µm. 6
5. Ascospores usually longer than 25 µm. 7

6. Fertile part cylindrical, ca. 5 cm X 5 mm diameter, on rooting base to 17 cm long, grey with yellowish tones. Ostioles punctate. Ascospores 19-23.5 X 7-8 µm, with long germ slit. . . . . *X.* cf. *lutea*

6. Fertile part fusiform, 3-5 cm X 0.4-1.2 cm diameter, on short stipe, tan to light orange to orange-red. Usually becoming hollow before maturity. Ostioles punctate. Ascospores (13-)17.5-25 X 6-7.5 µm, with slit short, oblique . . . . *X. telfairii* (For similar fungus with ascospores showing longer germ slit see *X.* aff. *telfairii* R 2199. See also *X. enterogena*)

7. Fertile part cylindrical to somewhat clavate, 4 mm diameter, on short to long stipe, up to 11 cm total length; with large wrinkles, otherwise smooth, dull black. Ostioles discoid. Ascospores (26.5-)29-34 X 5-6(-8) µm, with short germ slit . . . . *X.* cf. *aenea*

7. Fertile part clavate on short to long stipe, not usually exceeding 5 cm total height, smooth, light grey to whitish, becoming hollow. Ostioles punctate. 8

8. Ascospores 26.5-32 X 7.5-9 µm, with abrupt acute ends, with slit straight to oblique and less than spore-length . . . . *X. dealbata*

8. Ascospores 23-30 X 5-6 µm, with rounded ends, with short germ slit. . . . . *X.* cf. *kegeliana*

9. Fertile part clavate, on short stipe, 4 cm X 7 mm diameter, wrinkled and contorted, dull black. Ostioles discoid. Ascospores 7.5-9 X 3.5-4.5 µm . . . . *Xylaria* sp. (R 1965)

9. Fertile parts various. Ascospores much longer. 10

10. Fertile part cylindrical to clavate, on short or long stipe, up to 5 cm total length X 7 mm diameter, usually wrinkled and somewhat corky, dull black. Ascospores 16-23.5(-25) X (5-)6-7.5 µm, with short oblique to spiralling germ slit. . . . . *X. scruposa*

10. Fertile part variously shaped. Ascospores usually longer than 23.5 µm 11

11. Fertile part conical, subglobose, or irregular, sessile, 4 cm X 7 mm diameter, with prominent perithecial contours, white with black ostioles and orangish base. Ascospores 26.5-32.5 X 9.5-10.5(-13.5) µm . . . . *X. platypoda* var. *microspora*

11. Fertile part variously shaped, more or less stipitate, not predominantly white at maturity 12

12. Fertile part globoid to wedge-shaped, 5 mm diameter, on branched stipes up to 7 cm long, with corky surface, dull blackish with brown tones. Ostioles strongly discoid. Kretzschmarioid in general aspect. Ascospores 25-32 X 7.5-9 µm, with short, oblique germ slit . . . . *X. kretzschmarioidea*

12. Stromata not notably kretzschmarioid and character combinations otherwise different 13

13. Fertile part cylindrical to irregular, grading into stipe, 9 cm total length X 3-4 mm diameter, nodulose, with tomentum overall, dull black. Ascospores 23.5-28 X 7.5-9 µm, with pinched ends, with long spiral germ slit . . . . *X. nodulosa* var. *microspora*

13. Fertile parts various, not notably nodulose 14

14. Fertile part extremely variable -- fragariform, hemispherical, globoid, clavate -- sessile to stipitate, 0.4 cm-3 cm X 0.3-1 cm diameter, highly roughened with warts, wrinkles, and corkiness, dull black. Ascospores (20-)22-28(-30) X 7.5-9.5(-10.5) µm, with short, oblique to spiralling germ slit . . . . *X. anisopleura*

14. Fertile part clavate to irregular, 1-2.5 cm diameter, on long abrupt stipe, 5-6 cm total length, smooth except for major wrinkles, dull black. Ascospores 23.5-31 X 6.5-7.5 µm, with short, oblique to spiralling germ slit . . . . *X. schweinitzii*

SPECIES WITH SMALL STROMATA ON WOOD
(Stromata usually less than 5 mm in diameter)

1. Stromatal surfaces more or less smooth, usually tan, orange, white, or grey until blackening with age. 2

1. Stromatal surfaces more or less roughened with perithecial contours, coarse ostiolar papillae, warts, wrinkles, or all of the above, usually more or less black at maturity 11

    2. Fertile part globose. 3

    2. Fertile part cylindrical, conical, clavate, or irregular. 4

3. Fertile part 5 mm diameter, on narrow stipe 5 mm long, grey. Ascospores 29.5-37(-40) X (12-)13-15(-16) µm. . . . . *Xylaria* sp. (S 1836)

3. Fertile part 2-3 mm diameter, on narrow stipe up to 5 mm long, grey-olive. Ascospores 23.5-31 X 9.5-11 µm, with pinched ends . . . . *X. griseo-olivacea*

    4. Ascospores usually 17.5 µm or longer 5

    4. Ascospores usually not longer than 17.5 µm 7

5. Fertile part cylindrical with acute apex, 1-3 mm diameter, on narrow stipe, up to 4 cm total length, blackish with brown peeling layer. Ascospores 19-22 X 7.5-9 µm . . . . *X. apiculata*

5. Fertile part clavate on short stipe. Ascospores averaging smaller. 6

    6. Fertile part up to 6 cm X 1 cm diameter, but mostly smaller, yellow-white. Ostioles punctate. Ascospores (15-)16-21 X 6-7.5 µm, with short, oblique germ slit . . . . *X. enterogena*
    (Closely allied to *X. telfairii*)

    6. Fertile part 2.5 cm X 3 mm diameter, rusty orange. Ostioles more or less papillate. Ascospores 17.5-22 X 6.5-7.5 µm, with long spiralling germ slit . . . . *Xylaria* sp. (R 2264)

7. Fertile part cylindrical to long conical, ca. 2 mm diameter, on narrow, short or long stipe, up to 2 cm total length, black with grey peeling layer. Ascospores 14.5-17.5 X 6-6.5 µm, with short germ slit . . . . X. _arbuscula_
(A closely related fungus has a white peeling layer and ascospores (11.5-)12.5-13.5(-15) X 5-6 µm, with long germ slit. See R 2297).
7. Fertile part cylindrical, clavate, or irregular. Ascospores not longer than 15 µm 8

   8. Fertile part clavate, 3 mm diameter, on narrow stipe, up to 3 cm total length, lustrous grey with black ostioles. Ostioles more or less papillate. Ascospores (10.5-)11-14(-15) X 3.5-4.5 µm . . . . _X. plumbea_
   8. Fertile part variously shaped. Ascospores not longer than 12 µm 9

9. Fertile part cylindrical to clavate, 2.5 cm X 1-6 mm diameter, white with black ostioles, on short black stipe. Texture soft. Ostioles punctate. Ascospores (8-)9-10.5(-12) X 3.5-4.5(-5) µm. . . . . _X. microceras_
9. Fertile part cylindrical to clavate. Texture hard to very hard 10

   10. Fertile part clavate, 2 cm X 4 mm diameter, on short stipe, white becoming cinereus. Texture very hard. Ostioles punctate. Ascospores 9-10.5 X 3.5-4.5 µm . . . . _X._ cf. _pallida_
   10. Fertile part more or less cylindrical, often undulate from perithecial contours, 4 cm X 3 mm diameter, on short stipe, blackish with remnants of brownish peeling layer. Texture woody. Ascospores 9-10.5 X 3.5-4.5 µm. Ostioles punctate to slightly papillate . . . . _X. multiplex_

11. Fertile part bearing more or less immersed perithecia 12
11. Fertile part composed of individual perithecia or aggregations of more or less naked perithecia 14

12. Fertile part cylindrical to irregular, to 6 cm X 2-3 mm diameter, with short stipe, wrinkled circumferentially, blackish. Ascospores 13-15 X 4.5-5 μm . . . . *X. berkeleyi*

12. Fertile part not wrinkled circumferentially. Ascospores seldom longer than 9 μm 13

13. Fertile part cylindrical, 5 cm X 5 mm diameter, with short stipe, wrinkled and sometimes showing perithecial contours, dull black. Texture hard. Ascospores 6.5-9 X 3.5-4.5 μm . . . . *Xylaria* sp. (R 2072)

13. Fertile part cylindrical to clavate, 4 mm diameter, with narrow, short to long stipe, to 5 cm total length, black. Texture cheesy to woody. Ostioles discoid. Ascospores 7.5-9 X 4.5 μm. . . . . *X. feejeensis*

14. Ascospores not longer than 12.5 μm. 15

14. Ascospores not shorter than 17.5 μm. 16

15. Fertile branches bearing more or less naked perithecia on upper parts, 5 cm X 1-1.5 mm diameter, hairy overall, blackish. Ostioles slightly papillate. Ascospores (10.5-)12-12.5 X 4.5-5 μm. . . . . *X.* cf. *trichopoda*

15. Fertile part cylindrical, branched or unbranched, 1-2 mm diameter, with short or long stipe, 0.5 cm-2 cm total length, with more or less naked perithecia, cream with orange near base and becoming black. Ostioles papillate. Ascospores 9.5-10.5 (-12) X 3.5-4.5 μm. . . . . *X. coccophora*
(For similar fungi with immersed perithecia see S 1168 and S 1455)

16. Fertile part a rachis 30 cm X 1 mm diameter tapering to hair-breadth bearing naked individual perithecia at intervals, black. Ascospores 17.5-20 X 6.5-7.5 μm . . . . *Xylaria* sp. (S 1364)
NOTE: Also occurs on leaves.

16. Fertile part much shorter. Ascospores longer 17

17. Fertile part a rachis 6 cm X less than 1 mm diameter bearing aggregations of naked perithecia at intervals, black. Ascospores 22-25.5 X 6-7.5 µm . . . . *Xylaria* sp. (S 1330)
17. Fertile part a rachis up to 1 cm X 2-3 mm diameter bearing more or less naked perithecia, with short stalk and sterile apiculus, black. Ascospores 22-26.5 X 6.5-7.5(-9.5) µm . . . . *X.* aff. *theissenii*

SPECIES ON LEAVES, PETIOLES, AND FRUITS

1. Fertile parts of stromata conical, cylindrical, flattened, or subglobose. Perithecia immersed or contours distinct. 2
1. Fertile parts of stromata composed of aggregations of more or less naked perithecia 7

    2. Stromata on fruits (pods). 3
    2. Stromata on leaves and petioles. 5

3. Fertile part branched and flattened, without well-defined stipe, bearing perithecia with evident contours, tomentose overall, up to 5 cm, reddish brown to blackish. Ascospores 8-9.5 X 3-4 µm . . . . *X.* *culleniae*
3. Fertile part as above, but up to 8 cm long. Ascospores larger 4

    4. Ascospores 13-15(-17.5) X (3-)4-4.5(-5) µm, brown, with germ slit evident. . . . . *X.* cf. *ianthino-velutina*
    4. Ascospores 13-15(-17.5) X 3.5-4.5 µm, yellowish to brownish, the germ slit not always evident. . . . . *X.* aff. *magnoliae*

5. Fertile part subglobose, ca. 2 mm diameter, tan, on thin stipe up to 1.5 cm, white. Ascospores 11-13 X 7.5-9 µm, nearly black . . . . *Xylaria* sp. (S 1353)
5. Fertile part other than subglobose. 6

    6. Fertile part cylindrical, highly geniculate from insertion of strongly papillate perithecia, at least 1.5 cm X 0.5-0.75 mm diameter, brown. Ascospores 13.5-15 X 7.5-8 µm. . . . . *Xylaria* sp. (R 1741)

6. Fertile part cylindrical, more or less regular, 1-1.5 cm X 2 mm diameter, on thin hairy stipe 4 cm or longer, black with peeling brown layer. Ascospores 14.5-16 X 6.5-7.5 µm. . . . . *X*. cf. *brachiata*

7. Fertile parts sporadic clusters of more or less naked perithecia with intervening peg-like processes (coremia) on fine rachis up to 2 cm, black. Ascospores (9-)10.5-12 X 6.5-8(-9) µm. . . . . *X*. *asperata*

7. Fertile part cylindrical with flattened areas bearing more or less naked perithecia, the whole 1 cm long X 1 mm, black. Ascospores 9-10.5 X 5-6 µm . . . . . *Xylaria* sp. (R 2023)

Xylaria cf. *aenea* Mont., Ann. Sci. Nat. Bot. (ser. 4) 3:100. 1855. Figs. 1,2,6,33,36

Stromata cylindrical to clavate, up to 6 cm X 4 mm-1 cm diam, on short to long stipes up to 5 cm long, externally dull black, but probably once brown; internally white. Texture hard. Surface smooth except for few or many small wrinkles. *Perithecia* ca. 1 mm diam. Ostioles umbilicate, often discoid. *Asci* eight-spored, the spores usually arranged in a biseriate manner, cylindric-clavate, very long-stipitate, 320-330 µm total length X 13-17 µm broad, the spore-bearing part 140-150 µm long, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 4.5 µm high X 3 µm broad. *Ascospores* brown, unicellular or often bearing a cellular (primary) appendage at one end, inequilateral, fusoid or navicular, smooth, (26.5-)29-34 X 5-6(-8) µm, with germ slit straight to somewhat oblique, much less than spore-length.

SPECIMENS EXAMINED: R1955, R2003, R2004, R2068, R2470, R2515

NOTES: Our concept of this species is based on Dennis' description (1956). Our stromata are more slender than those described by Dennis and often have longer stipes. Dennis (1956) illustrated a specimen from Venezuela [Fendler 253 (K)]. JDR has examined this specimen which, although more robust than our material, has the same type of fusoid or navicular ascospore with a short slit. A photograph by J. H. Miller (in the possession of JDR) of stromata and ascospores of *X. aenea* (presumably from C. G. Lloyd material) likewise is of a robust specimen with ascospores identical to those depicted by Dennis and described herein. Indeed, Miller's photographs even show the biseriate arrangement of ascospores in an ascus. We thus feel justified in considering the cited collections to represent *X. aenea*.

Dennis (1956) illustrated and described *X. rickii* Theissen, a fungus that seems very much like our *X. aenea* in the size and morphology of stromata. Dennis (1956) remarked on the short germ slits in ascospores of this species. He gave ascospores as 18-25 X 5-7 µm, but noted that an annotation on the packet gave them as 25-32 X 6-8 µm. If, indeed, *X. rickii* has ascospores of this latter range its relationship to *X. aenea* might be closer than usually suspected. We have not seen material of *X. rickii*.

Xylaria anisopleura (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851.

Figs. 28,29,64

Stromata extremely variable in shape, cylindrical to clavate to globoid when upright to fragariform or hemispheric when hypoxyloid with short narrowed stipes or with narrow connective, 4 mm to 3 cm high X 3 mm to 1 cm diam; externally dark brown to brownish black, internally white. Texture cheesy or woody to hard. Surface rough from warts, wrinkles, corkiness, and, sometimes, ostioles. *Perithecia* 0.5-1 mm diam. Ostioles discoid, prominent or obscure. *Asci* eight-spored, cylindrical, stipitate, 250-260 µm total length X 8 µm broad, the spore-bearing part 160-180 µm, with apical ring bluing in Melzer's iodine reagent, more or less urn-shaped, 7.5-9 µm high X 4.5-5 µm broad. *Ascospores* brown to dark brown, unicellular, ellipsoid-inequilateral, smooth, (20-)22-28(-30) X 7.5-9.5(-10.5) µm, with germ slit much shorter than spore-length oriented oblique to spore axis or spiralling.

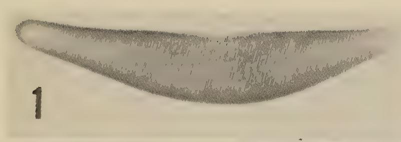
Colonies on oatmeal agar at ca. 20 C under 12 h fluorescent light covering 9 cm diam Petri dish in 3 wk, with mycelium at first velvety, white, zonate, with plumose, deeply lobed margins, later with thin layer of olive grey hyphae deposited predominately around developing stromata, surface becoming furrowed in a radiating pattern. Reverse at first pale orange, then brown. *Stromata* cylindrical, unbranched to branched several times at point of contact with Petri dish lid, developing abundantly over surface of colony, especially at periphery of zones and edge of Petri dish, ca. 1-1.5 cm high X 1-2 mm diam, at first white, but soon covered with orange exudation droplets before turning dark olive grey. Orange pigment not evident in other areas of the colony, disappearing as colony matures. No conidiogenous structures produced.

SPECIMENS EXAMINED: R2192 (cultured), R2483, R2517, S1210, S1346, S1432, S1568, S1839

NOTES: *Xylaria anisopleura* -- along with with *X. scruposa* and *X. schweinitzii* -- is a member of the difficult *X. polymorpha* complex. Members of this complex can be separated, in part, by cultural characteristics, as will be shown in a future paper. Our culture did not yield the anamorph, but a culture of BEC from Puerto Rico produces conidia on conidiophore palisades on stromatal surfaces. Conidia measure (8-)9(-10) X (3.5-)4 mm.

Figs. 1-23. 1-2. *Xylaria* cf. *aenea* (R1955). Ascospores, that in Fig. 2 showing germ slit, X 1600. 3-5. *X. asperata* (R1773). 3,4. Ascospores, that in Fig. 4 showing germ slit, X 1900. 5. Ascus apical ring, X 1900. 6. *X.* cf. *aenea* (R1955). Ascus apical ring, X 1900. 7-9. *X. griseo-olivacea*. 7,8. Ascospores, that in Fig. 8 showing germ slit, X 1600. 9. Ascus apical ring, X 1600. 10,11. *X. kretzschmarioidea*. Ascospores, that in Fig. 11 showing germ slit, X 1500. 12,13. *X.* cf. *kegeliana* (S1451). Ascospores, that in Fig. 13 showing germ slit, X 1600. 14. *X. kretzschmarioidea*. Ascus apical ring, X 1600. 15. *X.* cf. *kegeliana* (S1451). Ascus apical ring, X 1600. 16,17. *X. nodulosa* var. *microspora*. Ascospores, that in Fig. 16 showing portion of spiralling germ slit, X 1700. 18,19. *X. platypoda* var. *microspora*. Ascospores, that in Fig. 19 showing germ slit, X 1600. 20,21. *X. plumbea*. Ascospores, several in Fig. 21 showing germ slit, X 2200. 22. *X. platypoda* var. *microspora*. Ascus apical ring, X 1600. 23. *X. plumbea*. Ascus apical ring, X 1500.

Figs. 5,6,9,14,15,22,23 from material mounted in Melzer's iodine reagent. Other figures from material mounted in water. All photographs by brightfield microscopy.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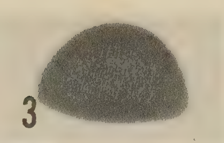
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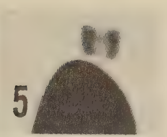
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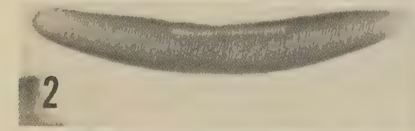
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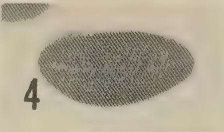
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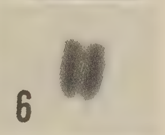
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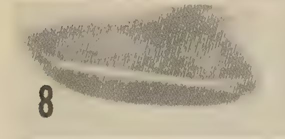
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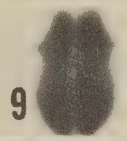
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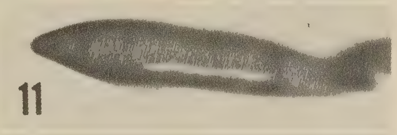
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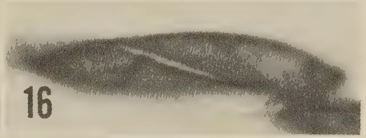
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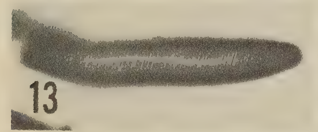
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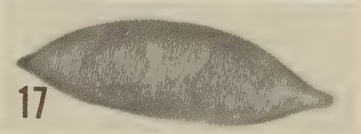
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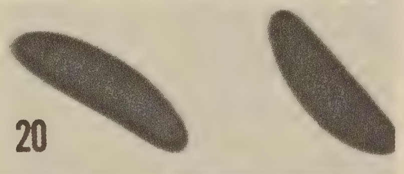
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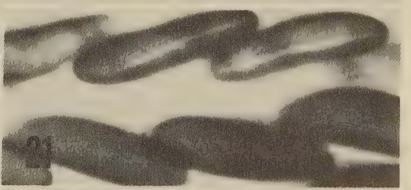
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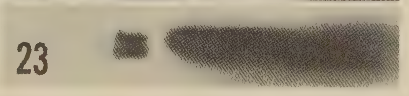
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Xylaria apiculata Cooke, Grevillea 8:66. 1879.

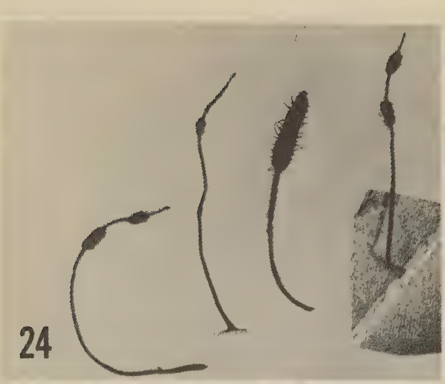
Stromata cylindrical to cylindric-conic with acute apices, 2-3 mm diam, on abruptly narrowed stipe comprising 1/3-2/3 total height, up to 4 cm high; externally black with brown peeling layer, internally white. Texture fairly hard. Surface smooth; stipe hairy. *Perithecia* 0.4-0.5 mm diam. Ostioles finely papillate. *Asci* eight-spored, cylindrical, stipitate, 165 µm total length X 10-11 µm broad, the spore-bearing part 115-120 µm long, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 6 µm high X 4.5 µm broad. *Ascospores* brown, unicellular or with a tiny cellular appendage (primary appendage) at one end, ellipsoid-inequilateral, smooth, 19-22 X 7.5-9 µm, with germ slit somewhat less than full-length.

Colonies on oatmeal agar at ca. 20 C under 12 h fluorescent light covering 9 cm diam Petri dish in 2 wk, with mycelium at first velvety, white, uniform, becoming covered with a greyish felty layer which later deepens to brownish black, overlaid in irregular patches with a thin layer of white mycelium. *Stromata* rudimentary, pulvinate to irregularly cylindrical, 1-5 mm tall X 1-2 mm diam, developing infrequently and scattered over surface of colonies. No conidiogenous structures produced.

SPECIMEN EXAMINED: R2043 (cultured)

NOTES: Our material resembles *X. apiculata* from various parts of the world. Rogers and Samuels (1986) described cultures from New Zealand material that were much as that described herein. Martin (1970) cultured *X. apiculata* and reported colonies to be pure white.

Figs. 24-32. 24-27. *Xylaria asperata*. 24. (R2224). Maturing stromata, one with anamorphic processes, X 2. 25. (R1758). Stromata with anamorphic processes. The swollen areas will bear perithecia, X 10. 26. (R2224). Teleomorphic head with remnants of anamorphic processes, X 6.5. 27. (R2224). Swollen area bearing mature perithecia, X 24. 28,29. *X. anisopleura* (R1986). 28. Stromata, X 4.5. 29. Stromatal surface, X 20. 30,31. *X.* cf. *brachiata*. 30. Stromatal surface with conspicuous perithecial contours, X 24. 31. Stroma, X 2. 32. *X. coccophora* (R1794). Stromata, X 5.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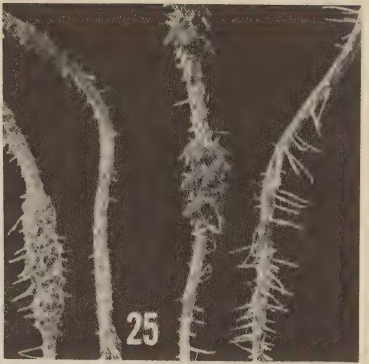
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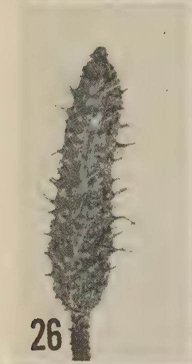
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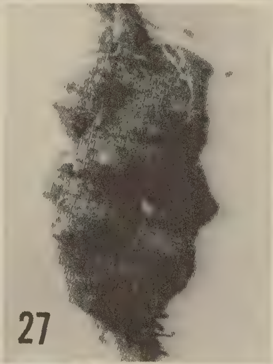
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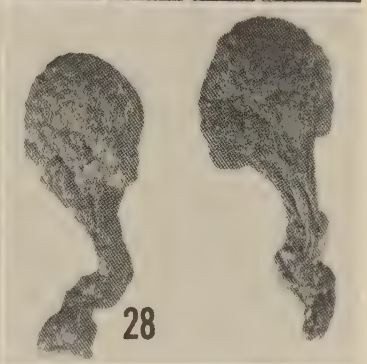
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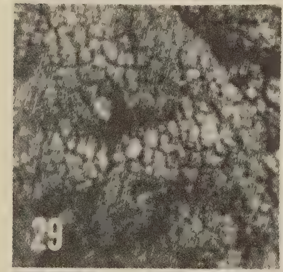
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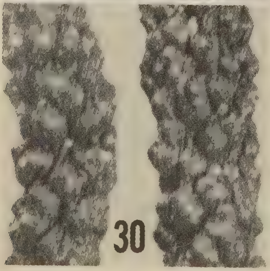
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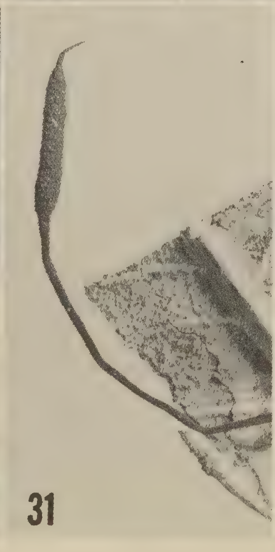
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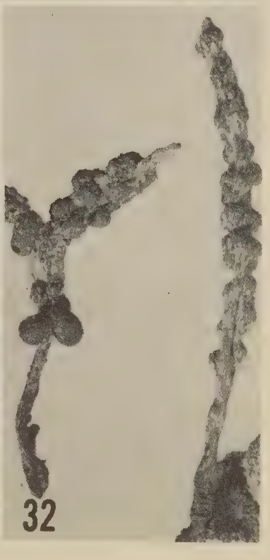
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Xylaria arbuscula Sacc., Michelia 1:249. 1878.

Fig. 67

Stromata cylindrical to long-conical with acute apices, 2-3 mm diam, on narrowed stipe comprising up to 1/2 of total height, up to 2 cm high; externally black with grey peeling layer, internally white. Texture fairly hard. Surface smooth; stipe hairy. Perithecia 0.4 mm diam. Ostioles slightly papillate. Asci eight-spored, cylindrical, 160-200 µm total length X 7-8 µm broad, the spore-bearing part 94-97 µm, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 3 µm high X 2 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 14.5-17.5 X 6-6.5 µm, with germ slit much less than spore-length.

Colonies on oatmeal agar at ca. 20 C under 12 h fluorescent light covering 9 cm diam Petri dish in 2-3 wk, with mycelium at first whitish, velvety, widely zonate, becoming overlaid with a greyish brown layer of felty mycelium darkening to brownish black and patchily covered in areas with a thin white mycelial layer. Reverse uncolored to pale brown. Stromata cylindrical, unbranched, up to 3.5 cm high X 1-2 mm diam, developing at periphery of zones and in large numbers at the periphery of colonies, greyish black with whitish interiors. No conidiogenous structures produced.

SPECIMENS EXAMINED: R2309 (cultured) R2297 (not typical)

NOTES: Specimen R2309 seems typical of the species. Specimen R2297 is much like the other described herein, but ascospores average smaller, (11.5-)12.5-13.5(-15) X 5-6 µm, and have long, undulate to spiralling germ slits.

Our cultures produced stromata, but did not produce the anamorph. They somewhat resemble cultures from New Zealand material which produced neither stromata nor the anamorph (Rogers & Samuels, 1986). Martin (1970) cultured material from Africa and reported only sterile stromata. Some collections of X. arbuscula from Brazil produce the anamorph in palisades on stromata and in tufts on the

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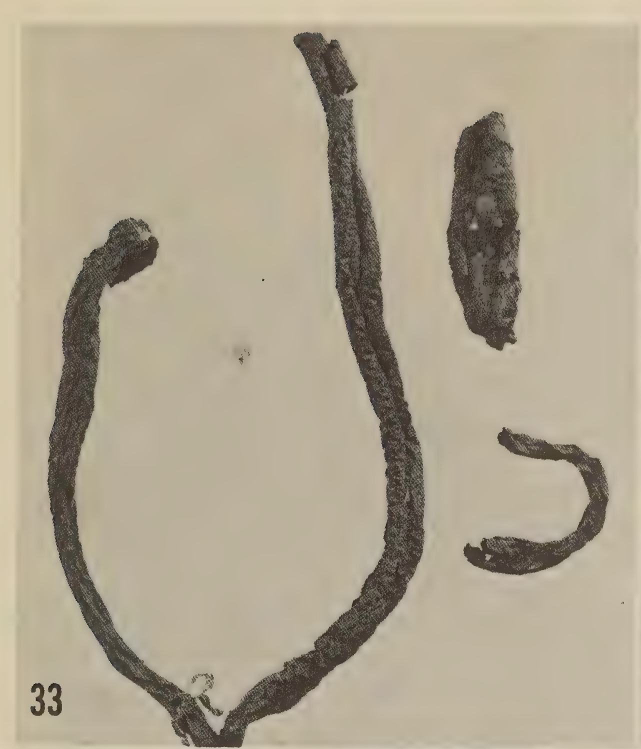
Figs. 33-37. 33. X. cf. aenea (R2064). Stromata, X 0.8. 34,35. X. griseo-olivacea. 34. Stromata, X 1.5. 35. Fertile head, X 15.5. 36. X. cf. aenea (R2064). Stromata surface, X 16. 37. X. ianthino-velutina. Stromata, X 1.6.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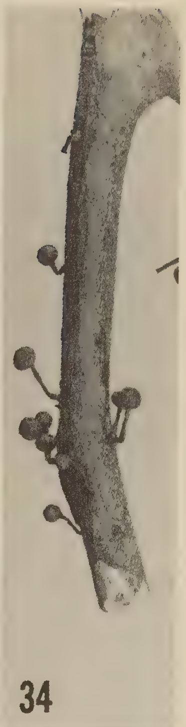
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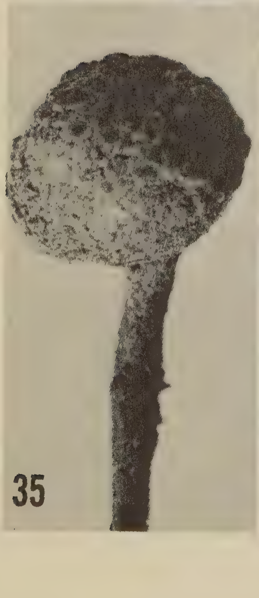
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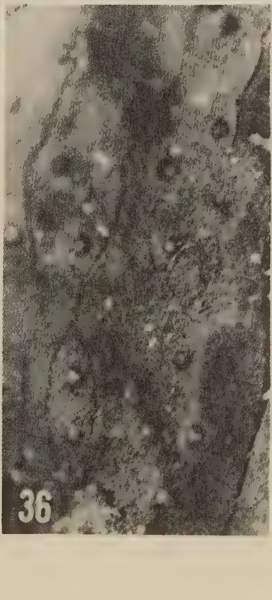
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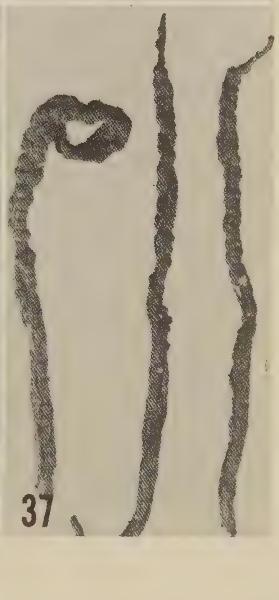
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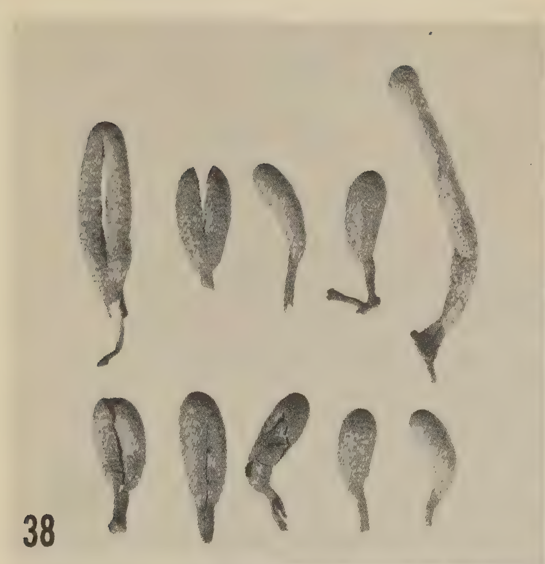
colony surface. Conidia are typically xylariaceous, 4-5 X 2 µm. Cultures from Brazilian material will be described in detail elsewhere.

Xylaria asperata J. D. Rogers, A. Y. Rossman & G. J. Samuels, *sp.* nov. Figs. 3-5, 24-27

Stromata filiformia 1-2 cm longa, ornata a dispersis aggregatis peritheciorum nudorum 1-2 mm longitudine X 1 mm diametro, et cylindricis vel conicis projecturis conidicis minus quam 1 mm longitudine dispersim super principalem axem; extus prima alba, tum nigrescentia, intus alba. Textura mollis. Superficies asperata a projecturis conidicis et aggregatis peritheciorum. Perithecia 0.3-0.4 mm diametro. Ostiola papillata. Asci octospori, cylindrici, stipitati, 120-150 µm longitudine tota X 9-11 µm crassi, partibus sporiferis 84-90 µm longitudine, annulo apicali in liquore iodato Melzeri cyanescente, rectangulari vel urceolato, 3 µm alto X 3 µm crasso. Ascosporae atrobrunneae, unicellulares, late ellipsoideo-inaequilaterales, leves, (9-)10.5-12 X 6.5-8(-9) µm, rima germinativa longa praedita. Status conidicus forma projecturarum (? coremia) dispersim super principalem axem. Conidiophora non clare observata. Conidia hyalina, levia, ellipsoidea, basibus parum complanatis.

Stromata filiform, 1-2 cm long, with scattered clusters *of naked* perithecia 1-2 mm long X 1 mm diam, with cylindrical to conical conidial projections less than 1 mm long scattered over main axis; externally at first white, becoming dull blackish; internally white. Texture soft. Surface roughened by conidial projections and perithecial aggregations. *Perithecia* 0.3-0.4 mm diam. Ostioles papillate. *Asci* *eight-spored*, cylindrical, 120-150 µm total length *X 9*-11 µm broad, the spore-bearing part 84-90 µm long, with apical ring bluing in Melzer's iodine reagent, rectangular to urn-shaped, 3 µm X 3 µm. *Ascospores* dark brown, unicellular, broad ellipsoid-*inequilateral*, smooth, (9-)10.5-12 X 6.5-8(-9) µm, with germ slit spore-length. *Anamorph* in the form of pegs (? coremia) scattered over *principal* axis. Conidiophores not clearly seen. *Conidia*

Figs. 38-42. 38. *Xylaria* cf. *kegeliana*. Stromata, X 1. 39. *X. lutea*. *Stromatal* surface, *X 16*. 40,41. *X. kretzschmarioidea*. 40. Fertile heads, X 3. 41. *Stromata, X 1.75*. 42. *X. lutea*. Stromata, X 1.2.



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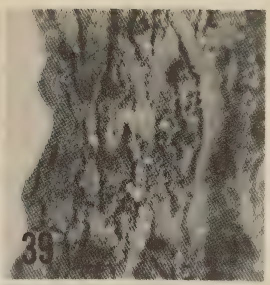

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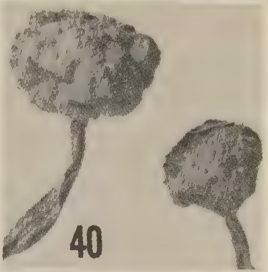

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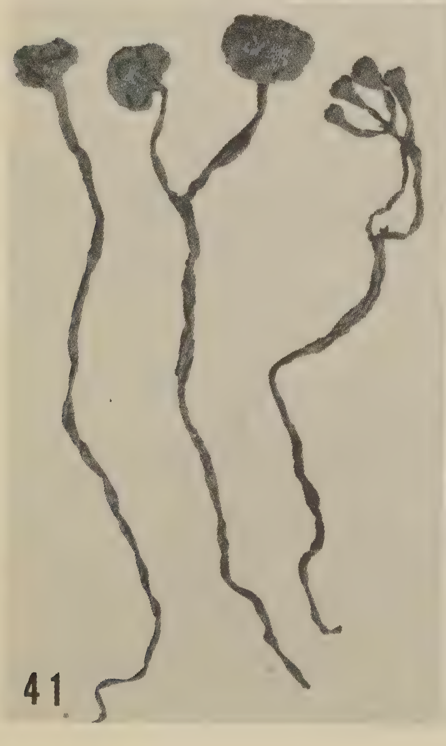

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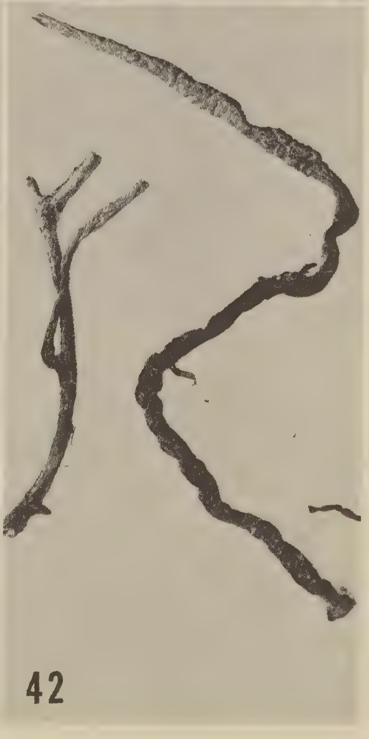

42

hyaline, smooth, ellipsoid, 4-6 X 1.5-2 μm, with slightly flattened bases.

SPECIMENS EXAMINED: R2224 (Holotype, VEN; Isotypes, BPI, JDR), R2380 (immature), R2394, S1410

NOTES: This fungus is most striking in the production of coremia on the rachis and the retention of these structures -- at least for some time -- on mature teleomorphic stromata. The affinities of this fungus are probably with *X. comosa* and *X. tentaculata*.

Xylaria berkeleyi Mont. apud Cooke, Grevillea 11:85. 1883.

Stromata cylindric-irregular on short stipe, up to 6 cm high X 2-3 mm diam, externally black, internally white. Texture hard. Surface roughened by circumferential wrinkles. *Perithecia* 0.5 mm diam. Ostioles obscure. *Asci* not intact; apical ring bluing in Melzer's iodine reagent, urn-shaped, 3 μm high X 1.5 μm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral to somewhat allantoid, 13-15 X 4.5-5 μm, with germ slit much less than full-length.

SPECIMEN EXAMINED: S1264

NOTES: Our material fits our concept of *X. berkeleyi* well. The wrinkles oriented around the circumference of the stroma are particularly diagnostic.

Xylaria cf. *brachiata* Sacc., Ann. Mycol 4:75. 1906.
Figs. 30,31

Stromata cylindrical with sterile acute apex, 1-1.5 cm long X 2 mm diam, with thin hairy stipe at least 4 cm long; externally black with peeling brown layer, internally white. Texture soft. Surface smooth except for ostioles, peeling layer, and stipe hairs. *Perithecia* ca. 0.2 mm

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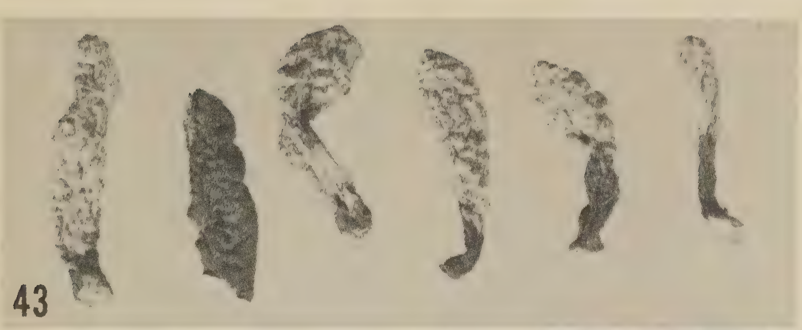
Figs. 43-48. 43. *Xylaria microceras* (R2085). Stromata, X 2. 44,45. *X. nodulosa* var. *microspora*. 44. Stromata, X 1. 45. Stromatal surface with perithecial contours, X 16. 46. *X. microceras* (R2085). Stromatal surface with wrinkles and ostioles, X 24. 47. *X. obovata*. Stromata, X 1. 48. *X. platypoda* var. *microspora*. Stromata, X 2.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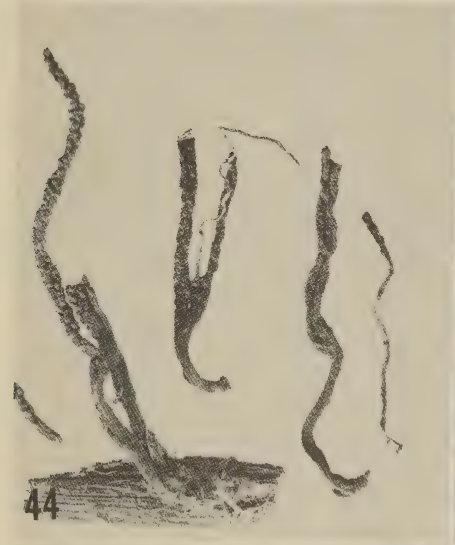
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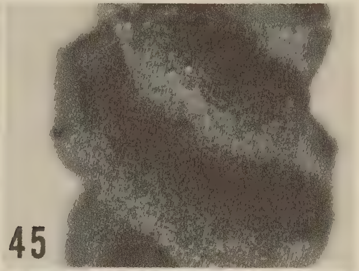
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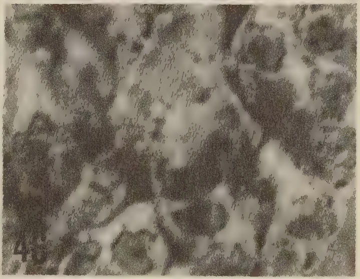
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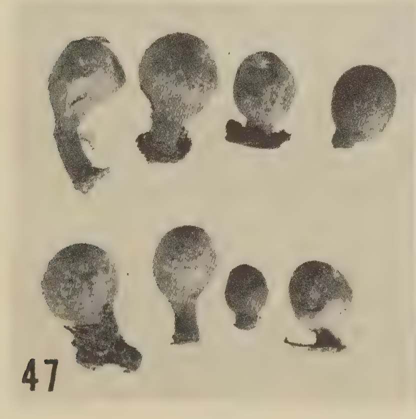
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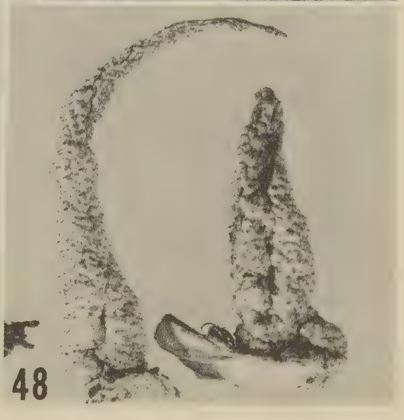
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diam. Ostioles discoid. Asci poor in this material, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 4 µm high X 3 µm broad. Ascospores dark brown, unicellular, broad ellipsoid-inequilateral, smooth, 14.5-16 X 6.5-7.5 µm, with germ slit straight or undulating, spore-length.

SPECIMENS EXAMINED: R2233, R2284. R2232 might represent immature material.

NOTES: This fungus is not known to us. It might be assignable to X. brachiata Sacc. We have not seen authentic material of that species. Dennis (1957) considers X. brachiata to be synonymous with X. mellisii (Berk.) Cooke [as Xylosphaera mellisii (Berk.) Dennis].

Xylaria coccophora Mont., Ann. Sci. Nat. Bot. (sér. 4) 3:109. 1855. Figs. 32,65

Stromata cylindrical, simple or with a few branches, with acute apices, with short or long stipes, 5 mm - 2 cm high X 1-2 mm diam; externally cream-colored often with areas of bright orange; internally white. Texture soft. Surface smooth except for perithecial contours. Perithecia 0.5-0.7 mm diam. Ostioles more or less papillate. Asci eight-spored, cylindrical, stipitate, 160 µm total length X 6-7 µm broad, the spore-bearing part 75-85 µm, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 2-3 µm high X 2-3 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 9.5-10.5(-12) X 3.5-4.5 µm, with germ slit slightly or considerably less than full-length.

Colonies on oatmeal agar at ca. 20 C and under 12 h fluorescent light covering 9 cm Petri dish in 3 wk, at first velvety, appressed, some with plumose margins, irregularly zonate to uniform, becoming covered with blackish mycelium, in turn overlaid with white, or in some isolates, yellow mycelium, the latter bearing aggregates of pigmented irregular excrescences on hyphal surfaces. Reverse pale reddish-orange. Stromata narrowly cylindrical, up to 2 cm

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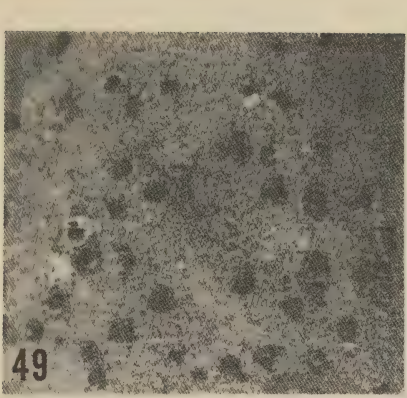
Figs. 49-53. 49. Xylaria obovata. Stromatal surface, X 9. 50. X. platypoda var. microspora. Stromatal surface, X 16. 51,52. X. plumbea. 51. Stromata, X 1.6. 52. Stromatal surface, X 24. 53. X. scruposa (R1882). Stromata, X 2.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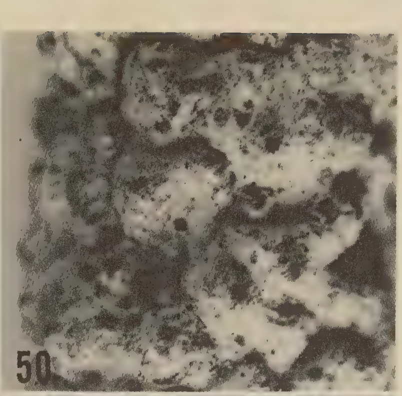
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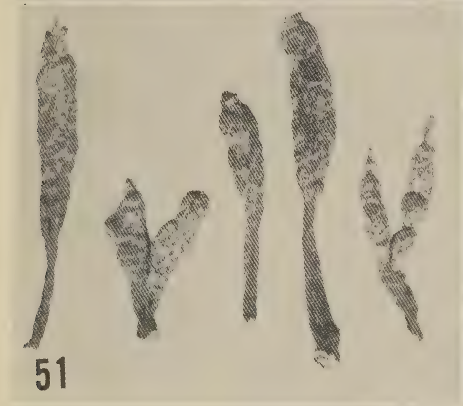
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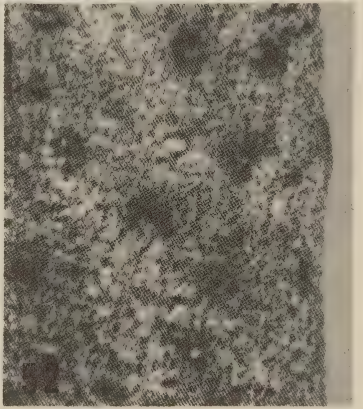
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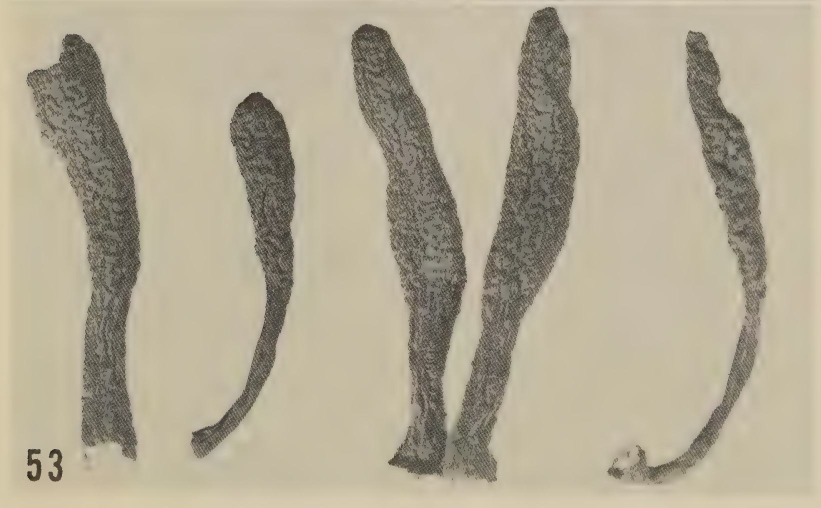
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tall X .5-1 mm diam, to clavate or flabelliform, 0.5-1 cm tall X 3-4 mm diam, produced on surface and periphery of colony, at first white, then covered except for growing tips with thin black layer and a second white to yellow layer of more or less parallel hyphae. Conidium-bearing regions on basal surfaces of stromata and on small, pulvinate protrusions on agar, but not seen on areas bearing yellow hyphae. *Conidiophores* upright in palisades, sparingly branched near base, white to pale brownish in mass, smooth-walled. *Conidiogenous cell* terminal, cylindrical, 20-30 X 4-6 μm, bearing denticular conidial secession scars. Conidia produced holoblastically in sympodial sequence. *Conidia* hyaline, smooth, narrow ellipsoid, guttulate, with flattened to slightly flared bases indicating former points of attachment to condiogenous cell, (7-)8-9 (-10) X (2.5-)3-4 μm. Conidia germinating in culture.

SPECIMENS EXAMINED: R1794 (cultured), S1484, S1525 (cultured), S1618 (cultured). S1168 and S1455 are somewhat atypical in having immersed perithecia.

NOTES: Except where noted above, our collections seem entirely typical of *X. coccophora*.

Cultures from S1525 and S1618 were as described. Specimen R1794 yielded a white floccose culture devoid of the anamorph.

Xylaria comosa (Mont.) Fr., Summa Veg. Scand. Sect. Post., p. 381. 1849.

Stromata oblong, 3 cm long X 1 cm diam, on long thin stipes up to 5 cm long X 1 mm diam; externally blackish with white sloughing patches; internally white. Texture very hard. Surface smooth except for remnants of conidial processes below fertile part and dense short hairs on stipe. *Perithecia* ca. 1 mm diam. Ostioles obscure. *Asci* not intact; apical ring bluing in Melzer's iodine reagent,

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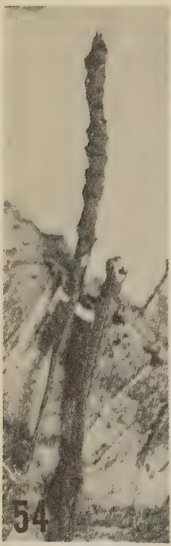
Figs. 54-60. 54,55. *Xylaria* sp. (R1741). 54. Stroma on leaf, X 6. 55. Portion of stroma showing geniculate appearance owing to perithecial elevations and ostioles, X 20. 56,57. *Xylaria* sp. (R2264). 56. Mature teleomorphic stromata, X 6. 57. Anamorphic stromata, X 1.5. 58. *Xylaria* sp. (S1353). Fertile head and short portion of stipe, X 24. 59,60. *Xylaria* sp. (S1364). 59. Perithecia on rachis, X 24. 60. Stroma, X 1.75.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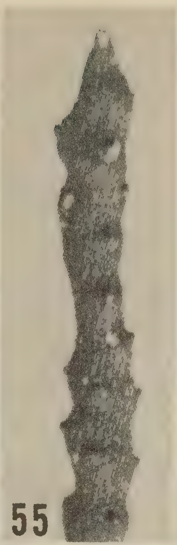
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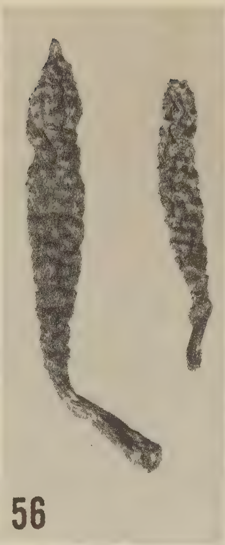
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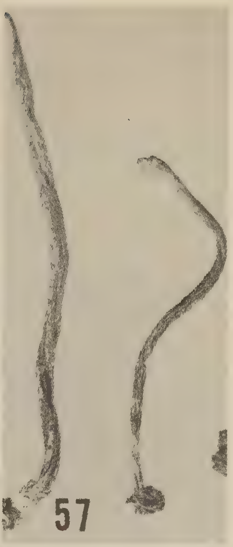
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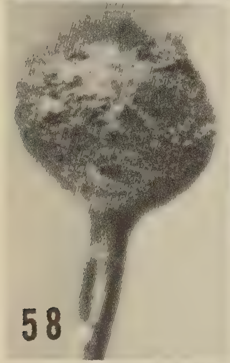
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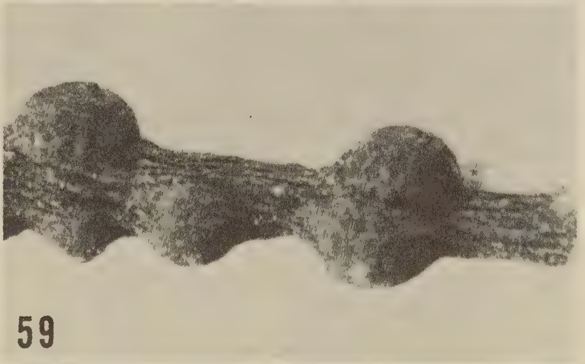
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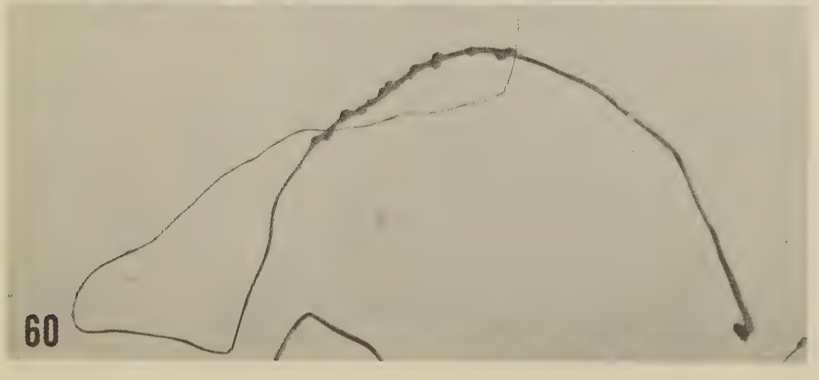
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more or less urn-shaped, 10.5 μm high X 7.5 broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral *with abrupt* pinched ends, smooth, 31-35 X 8-9 μm, with germ slit spiralling, spore-length.

SPECIMEN EXAMINED: S1801

NOTES: Our material is much as described and illustrated by Dennis (1956).

Xylaria cubensis (Mont.) Fr., Nova Acta Regiae Soc. Sci. *Upsal. (ser.* 3) 1, p. 126. 1851.

Stromata clavate with short stipe, 3 cm high X 1 cm diam, *externally* copper-colored, becoming blackened; internally white, becoming hollow and inrolled. Texture hard, but fragile. Surface smooth except for finely papillate ostioles and fine cracking. *Perithecia* 0.4 mm diam. Ostioles finely papillate. *Asci not intact*. Ascus apical ring bluing in Melzer's *iodine reagent*, rectangular or inverted hat-shaped, minute. *Ascospores* brown, unicellular, ellipsoid-inequilateral, *smooth, 9 X* 3.5-4.5 μm, with germ slit unclear, but probably long.

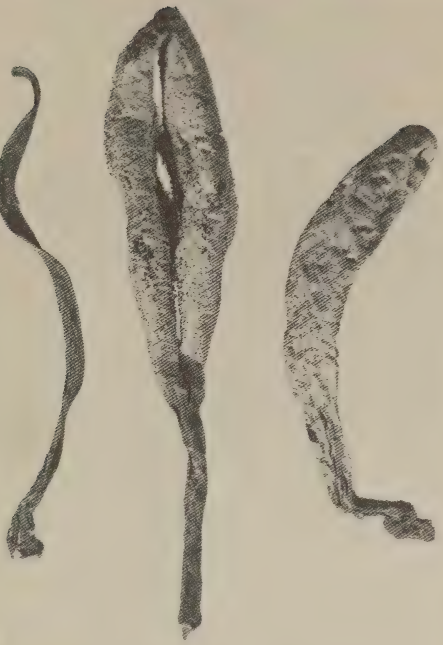
SPECIMEN EXAMINED: R1785

NOTES: Our material seems typical for the species. Rogers (1984) has discussed *X. cubensis* and its *Xylocoremium* J. D. Rogers anamorph.

Xylaria culleniae Berk. & Broome, J. Linn. Soc. Bot. *14:119. 1875.*

Stromata unbranched or branched, cylindrical, long *conical, or flattened*, the fertile parts bearing more or less naked perithecia, grading into ill-defined stipes; externally blackish, internally white. Texture soft. Surface roughened with perithecia and tomentose except for stromatal apices. *Perithecia* ca. 0.2-0.3 mm diam. Ostioles minutely *papillate*. *Asci* poor in this material, the apical ring bluing in *Melzer's* iodine reagent, more or less rectangular, 2 μm high X 1.5 μm broad. *Ascospores*

Figs. 61-63. 61. *Xylaria telfairii* (S1561). Stromata, X 1. 62,63. *X.* cf. *theissenii*. *62.* Perithecial elevations, X 24. 63. *Stromata,* X 4.



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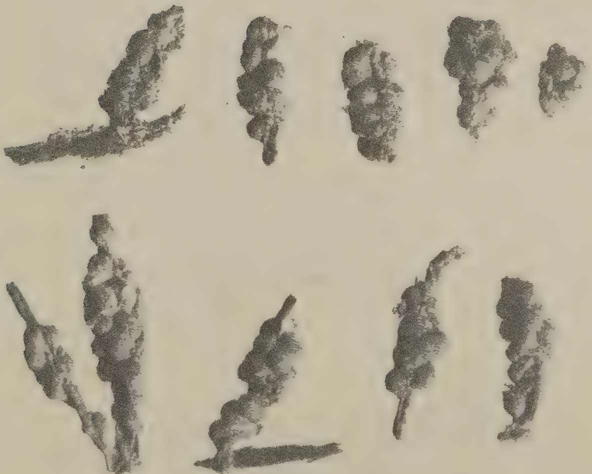

63

brown, unicellular, ellipsoid-inequilateral, smooth, 8-9.5 X 3-4 μm, with germ slit slightly less than spore-length.

SPECIMEN EXAMINED: S1159

NOTES: *Xylaria culleniae* is closely related to *X. ianthino-velutina* and detailed studies may show it to be a small-spored variety of the latter (Dennis, 1956; Joly, 1968; Rogers, 1979). We were unfortunately unable to culture our fungus. See also remarks herein on *X.* aff. *magnoliae* and *X.* cf. *ianthino-velutina*.

Xylaria dealbata Berk. & Curt., J. Acad. Nat. Sci. Philadelphia, N.S. 2:284. 1853.

Stromata clavate, 4 cm long X 5-7 mm diam, with narrowed stipe up to 5 cm long, externally egg-shell white to greyish; internally tan to blackish, becoming hollow and inrolled. Texture very hard. Surface smooth. *Perithecia* 0.7 mm diam. Ostioles punctate, obscure. *Asci* not intact; apical ring bluing in Melzer's iodine reagent, more or less urn-shaped, 6.5 μm long X 4 μm broad. *Ascospores* nearly black, unicellular, ellipsoid-inequilateral with abrupt acute apices, smooth, 26.5-32 X 7.5-9 μm, with slit less than full-length, oriented parallel to the axis of the spore or oblique to it.

SPECIMENS EXAMINED: I740, R2143, S1183, S1425, S1468, S1818, S1926

NOTES: Our material seems typical of *X. dealbata*. It has been well-described and illustrated by Dennis (1956). The putative conidial state has been described by Rogers, Callan & Samuels (1987).

Xylaria enterogena (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851.

Stromata clavate on short stipes, up to 6 cm high X 1 cm diam; externally yellow-white, internally white, becoming brownish. Texture fairly hard. Surface smooth, more or less laccate. *Perithecia* 0.5 mm diam. Ostioles punct-

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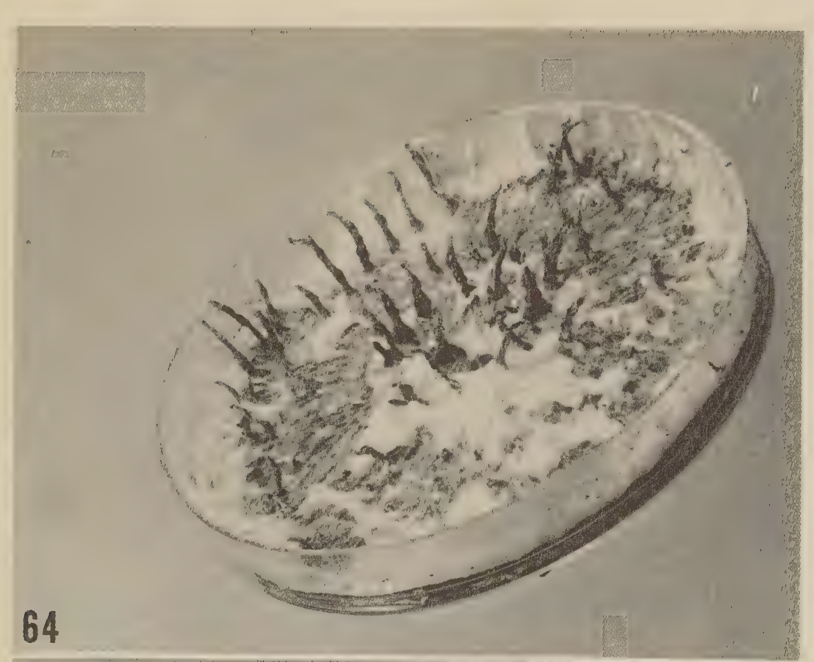
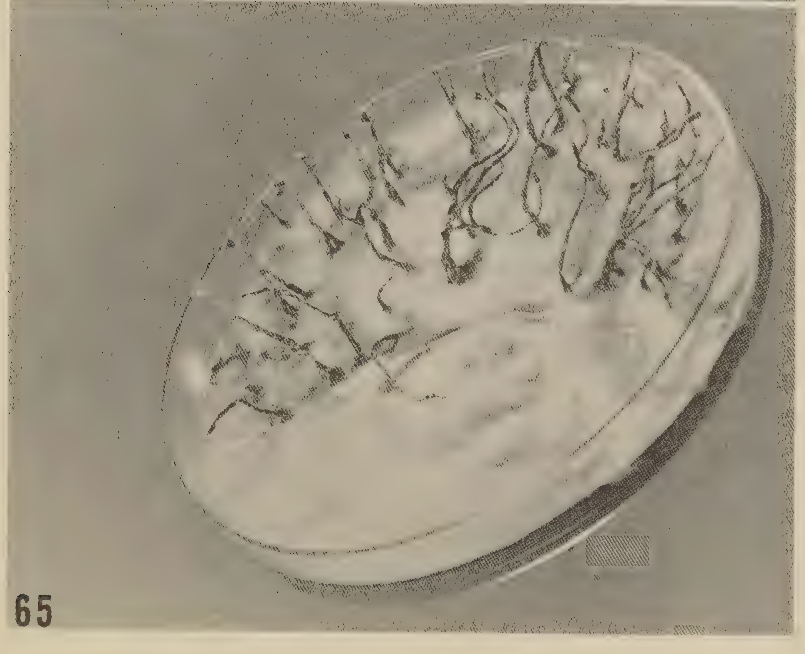
Figs. 64, 65. 64. *Xylaria anisopleura*. Culture bearing immature stromata, X 1. 65. *X. coccophora*. Culture bearing immature stromata, X 1.



64



65

ate. *Asci* not intact; apical ring bluing in Melzer's iodine reagent, urn-shaped, 4.5 µm high X 3 µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral to crescentic with rounded apices, smooth, (15-)16-21 X 6-7.5 µm, with germ slit short, oriented oblique to axis of spore.

SPECIMENS EXAMINED: I127, R2425, S1450, S1458, S1698

NOTES: Dennis (1956) considered *X. enterogena* to be a small state of *X. telfairii*. We consider *X. enterogena* to be a separate species, albeit closely related to *X. telfairii*. It differs from *X. telfairii* primarily in its yellow-white color, its smaller stature, and its smaller (average) ascospores with rounded ends. Cultural features of *X. enterogena* and *X. telfairii* are very similar (unpublished data).

Xylaria feejeensis (Berk.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 128. 1851.

Stromata cylindric-clavate on stipe comprising 1/3-1/2 total height, 5 cm high X 4 mm diam, externally black, internally white. Texture cheesy. Surface roughened by small wrinkles and ostioles. *Perithecia* 0.3 mm diam. Ostioles discoid. *Asci* not intact; apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, minute. *Ascospores* brown, unicellular, ellipsoid-inequilateral, smooth, 7.5-9 X 4.5 µm, with germ slit full-length.

SPECIMENS EXAMINED: S1521, S1768

NOTES: This collection fits our concept of the species. The species seems present in the tropics worldwide. Dennis (1956) should be consulted for synonymy.

Xylaria griseo-olivacea J. D. Rogers & A. Y. Rossman, sp. nov. Figs. 7-9, 34,35

Stromata globosa 2-3 mm diametro, stipitibus perangustis 2-5 mm altis, extus griseo-olivacea, intus alba; stipites nigri. Textura fragilis. Partes fertiles pulverulentae; stipitibus hispidis. Perithecia 1 mm vel

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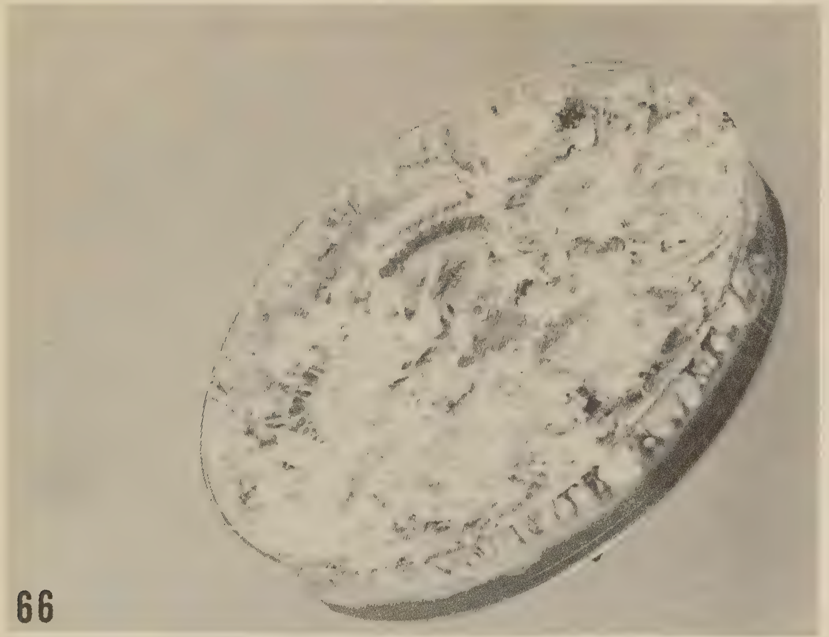
Figs. 66,67. 66. *Xylaria scruposa*. Culture, X 1. 67. *X. arbuscula*. Culture, X 1.1.



66

67

plus diametro, in capitulo quoque 1-3. Ostiola inconspicua. Asci saepe biseriati, octospori, cylindrici vel clavati, stipitati, 200 µm longitudine tota X 19 µm crassi, partibus sporiferis 145 µm longitudine, annulo apicali in liquore iodato Melzeri cyanescente, plus minusve urceolato, 9 µm alto X 6 µm crasso. Ascosporae atrobrunneae, unicellulares vel cellulari appendicula minuta hyalina (appendicula primaria) in uno extremo, ellipsoideo-inaequilaterales extremis abrupte constrictis, leves, 23.5-31 X 9.5-11 µm, rima germinativa longa praedita. Status anamorphosis ignotus.

Stromata globose, 2-3 mm diam, with very narrow stipes 2-5 mm high, externally olive with grey tones, internally white; stipes black. Texture brittle. Fertile parts pulverulent, stipes with short hair. *Perithecia* 1 mm or (+) diam, 1-3 per head. Ostioles inconspicuous. *Asci* eight-spored, the spores partially biseriate, cylindrical to clavate, stipitate, 200 µm total length X 19 µm broad, the spore-bearing part 145 µm, with apical ring bluing in Melzer's iodine reagent, more or less urn-shaped, 9 µm high X 6 µm broad. *Ascospores* dark brown, unicellular or with minute hyaline cellular appendage (primary appendage) on one end, ellipsoid-inequilateral with abruptly pinched ends, smooth, 23.5-31 X 9.5-11 µm, with straight germ slit spore-length. Anamorph unknown.

SPECIMEN EXAMINED: R1736 (Holotype, VEN; Isotype, BPI, JDR).

NOTES: This is a strikingly beautiful fungus.

Xylaria cf. *ianthino-velutina* (Mont.) Fr., Nova Acta Regiae *Soc. Sci. Upsal. (ser. 3)* 1, p. 128. Fig. 37

Stromata unbranched or branched, cylindrical, long conical, or flattened, the fertile parts bearing more or less naked perithecia, grading into ill-defined stipes; externally dark reddish brown to blackish, internally white. Texture soft. Surface roughened with perithecia and tomentose except for stromatal apices which usually bear traces of anamorph. *Perithecia* ca. 0.5 mm diam. Ostioles more or less papillate. *Asci* poor in this material, with apical ring bluing in Melzer's iodine reagent, rectangular to urn-shaped, 3 µm high X 1.5 µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral to fusoid, smooth, 13-15(-17.5) X (3-)4-4.5 (-5) µm, with germ slit spore-length or nearly so.

SPECIMENS EXAMINED: R1766, R1772, S1173, S1189, S1530

NOTES: This fungus occurs on tough fruits, including those of the legume genus *Elizabetha*. As far as we are aware, *X. ianthino-velutina* usually (? always) occurs on legume fruits. Although the fungus in question greatly resembles *X. ianthino-velutina*, its spores average longer and tend to be more fusoid (Dennis, 1956; Rogers, 1979). Indeed, its spores resemble those of *X. magnoliae* J. D. Rogers in shape, but are darker and have definite germ slits (Joly, 1968; Rogers, 1979). Moreover, *X. magnoliae* is confined to *Magnolia* fruits in North America, as far as we are aware (Rogers, 1979). Unfortunately, we have been unable to culture the present fungus. *Xylaria magnoliae* has been cultured (Chacko & Rogers, 1981). See also remarks on *X.* aff. *magnoliae* and *X. culleniae* herein.

Xylaria cf. *kegeliana* (Lév.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 125. 1851.

Figs. 12,13,15,38

Stromata clavate, 1-4 cm X 4-10 mm diam, on abruptly narrowed stipes up to 1.5 cm, externally dull grey with tan tones and sometimes mottled with white, becoming dull blackish, with stipes concolorous to black; internally white, becoming hollow. Texture very hard. Surface very smooth with fine lines. *Perithecia* 0.5-1 mm or (+) diam. Ostioles punctate, inconspicuous. *Asci* eight-spored, usually biseriate, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, somewhat urn-shaped, 4.5-6 µm high X 3 µm diam. *Ascospores* brown, unicellular, inequilateral, fusoid to navicular or allantoid, with rounded apices, smooth, 23-30 X 5-6 µm, with germ slit much less than spore-length, oriented with axis of spore or oblique to it.

SPECIMENS EXAMINED: S1427, S1451

NOTES: Our concept of this species is very tentative. Dennis (1956) depicts it from type material as having stromata with acute apices and ascospores with acute ends. A photograph of Cuban material by the late J. H. Miller (in possession of JDR) shows stromata with ascospores with narrowed rounded apices and long spiralling germ slits. Joly (1968) remarked on the narrow aspect (high length: width ratio) of the ascospores of type material. Unfortunately, neither Joly nor Dennis recorded information on germ slit morphology or ascus tips. Dennis (1956) noted that, in color and spores, X. kegeliana resembles X. dealbata. Our material resembles X. dealbata in color, but the ascospores of our material differ in having rounded rather than pointed ends. Indeed, the ascospores of our fungus greatly resemble those of X. aenea and those depicted by Miller for Cuban material of X. kegeliana. Our material does not otherwise resemble X. aenea and ascospore germ slits of our material are short and straight to oblique with no tendency to spiral. Other tropical collections and cultures should eventually clarify this problem.

Xylaria kretzschmarioidea J. D. Rogers & A. Y. Rossman, sp. nov. Figs. 10,11,14,40,41

Capitula stromatum globosa vel cuneata vel irregularia usque ad 5 mm diametrum, stipitibus perangustis teretibus vel complanatis et tortis, ramosis vel haud ramosis circa 7 cm longitudine; extus memnonia, intus alba. Textura dura. Superficies plus minusve suberosa. Perithecia 1 mm diametro. Ostiola fortiter discoidea. Asci octospori, cylindrici, longe stipitati, 250-325 μm longitudine tota X 9 μm crassi, partibus sporiferis 140-170 μm longitudine, annulo apicali in liquore iodato Melzeri cyanescente, doliiformi vel plus minusve urceolato, 7 μm alto X 4 μm crasso. Ascosporae brunneae, unicellulares, ellipsoideo-inaequilaterales vel naviculares, extremis acutis, leves, 25-32 X 7.5-9 μm, rima germinativa brevi obliqua. Status anamorphosis ignotus.

Stromatal heads globoid, wedge-shaped, or irregular up to 5 mm diam, with thin, terete or flattened and twisted, unbranched or branched stipes up to 7 cm long; externally dull blackish with brown tones, internally white. Texture hard. Surface more or less corky. Perithecia 1 mm diam. Ostioles strongly discoid. Asci eight-spored, cylindrical, long-stipitate, 250-325 μm total length X 9 μm, the spore-bearing part 140-170 μm, with apical ring bluing in Melzer's iodine reagent, barrel-shaped to somewhat urn-shaped, 7 μm high X 4 μm broad. Ascospores brown, unicellular, ellipsoid- inequilateral to navicular, with acute ends, smooth, 25-32 X 7.5-9 μm, with short oblique germ slit.

SPECIMEN EXAMINED: R2010 (Holotype, VEN; Isotype, BPI, JDR).

NOTES: This fungus superficially resembles a long-stalked Kretzschmaria, but with firm persistent interior flesh. It probably does not become hollow like many Kretzschmaria species.

Xylaria cf. lutea Beeli, Bull. Soc. Roy. Bot. Belg. 58:204. 1926. Figs. 39,42

Stromata cylindrical, up to 5 cm X 4 mm diam, terete or flattened, on branches of rooting stipes up to 17 cm long, externally grey with yellowish tones, becoming black; internally white. Texture hard. Surface smooth except for tiny wrinkles and shredding yellow layer. Perithecia 0.7 mm diam. Ostioles umbilicate, sometimes slightly raised. Asci eight-spored, cylindrical, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, rectangular, 4.5 μm high X 3 μm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral, smooth, 19-23.5 X 7-8 μm, with germ slit slightly less than spore-length.

Conidia borne on apices of mature stromata, probably covering entire juvenile stromata, hyaline, smooth, long ellipsoid with flattened bases indicating former points of attachment to condiogenous cell, 7-9 X 2-3 μm.

SPECIMEN EXAMINED: S1542

NOTES: This species was originally described from Africa. Dennis' description (1961)(as Xylosphaera) fits it well. We have not seen type material.

Xylaria sp. aff. magnoliae J. D. Rogers, Can. J. Bot. 57: 941. 1979.

Stromata unbranched or branched, cylindrical, long conical, or flattened, the fertile parts bearing more or less naked perithecia, grading into ill-defined stipes, externally reddish brown to blackish, internally white. Texture soft. Surface roughened with perithecia and tomentose except for stromatal apices which usually bear traces of anamorph. Perithecia ca. 0.5 mm diam. Ostioles more or less papillate. Asci eight-spored, the spores arranged in partially biseriate manner, cylindric-clavate, stipitate, 120-140 μm total length X 9 μm broad, the spore-bearing part 75 μm long, with apical ring bluing in Melzer's iodine reagent, more or less rectangular, 3 μm high X 1.5 μm wide. Ascospores yellowish to brownish, unicellular, fusoid-inequilateral, smooth, 13-15(-17.5) X 3.5-4.5 µm, with germ slit often difficult to discern, straight to undulate, nearly spore-length.

SPECIMEN EXAMINED: R1740

NOTES: This fungus bears a striking resemblance to those referred to *X.* cf. *ianthino-velutina* herein, differing primarily in the pale ascospores. It resembles *X. magnoliae* J. D. Rogers in ascospore size, but the latter is confined to *Magnolia* in North America as far as we are aware (Rogers, 1979). Moreover, the ascospore germ slit of *X. magnoliae* is obscure, whereas that of the present fungus can usually be seen. It is probable that this fungus is a variant of *X.* cf. *ianthino-velutina* described herein. Unfortunately, we were unable to culture this fungus and, moreover, have never cultured typical *X. ianthino-velutina*. Cultural comparisons might help elucidate this problem. See also remarks on *X.* cf. *ianthino-velutina* and *X. culleniae* herein.

Xylaria microceras (Mont.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 128. 1851. Figs. 43,46

Stromata cylindrical to clavate on short stipes, up to 2.5 cm high X 1-6 mm diam; externally at first white with black stipes and ostioles, becoming black overall; internally white. Texture fairly hard. Surface with fine wrinkles. *Perithecia* 0.2 mm diam. Ostioles more or less punctate. *Asci* eight-spored, cylindrical, stipitate, 125-130 µm total length X 6 µm broad, the spore-bearing part 55 µm, with apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, 2 µm high X 1.5 µm wide. *Ascospores* brown, unicellular, ellipsoid-inequilateral, smooth, (8-) 9-10.5(-12) X 3.5-4.5(-5) µm, with germ slit full-length or nearly so.

Colonies on oatmeal agar at ca. 20 C and under 12 h fluorescent light covering 9 cm diam Petri dish in 2 wk, with mycelium at first white, faintly zonate towards center, becoming covered with plumose patterns of brownish-grey hyphae. Reverse brownish-black. No stromata or conidiogenous structures produced.

SPECIMENS EXAMINED: R2085 (cultured), R2164

NOTES: Our specimens seem typical for the species.

Xylaria multiplex (Kunze) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851; sensu Dennis, Kew Bull. 1956: 416. 1956.

Stromata cylindrical-clavate on short stipes with pannose bases, up to 4 cm high X 3 mm diam, externally blackish with remnants of brown peeling layer; internally whitish to tan. Texture hard. Surface undulate to nodulose from perithecial contours, otherwise smooth. Perithecia 0.3-0.5 µm diam. Ostioles more or less punctate. Asci not intact; apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, 2 µm high X 1.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 9-10.5 X 3.5-4.5 µm, with germ slit slightly less than full-length.

SPECIMENS EXAMINED: I104, I115, I501, S1257

NOTES: Our material is much as described by Dennis (1956), whose concept of the species we accept. Saccardo (1882) described the species as having much larger ascospores.

Xylaria nodulosa Lloyd var. microspora J. D. Rogers & G. J. Samuels, var. nov. Figs. 16,17,44,45
Typical variety, Mycol. Notes 6:1007. 1920.

A varietate typica differt in ascosporis 23.5-28 X 7.5-9 µm.

Differs from the typical variety in size of ascospores 23.5-28 X 7.5-9 µm.

Stromata long cylindrical-irregular, up to 9 cm X 3-4 mm, grading into an ill-defined stipe, externally dull black, internally white. Texture hard. Surface roughened with perithecial contours and clothed in hair. Perithecia ca. 1 mm diam. Ostioles slightly papillate. Asci apparently eight-spored, more or less cylindrical, poor condition in this material, with apical rings bluing in Melzer's iodine reagent, rectangular to urn-shaped, 6-6.5 µm high X 2-3 µm broad. Ascospores light brown, unicellular or with a hyaline cellular appendage (primary appendage) at one end, ellipsoid-inequilateral with abrupt pinched ends, smooth, 23.5-28 X 7.5-9 µm, with long spiral germ slit.

SPECIMEN EXAMINED: S1206 (Holotype, VEN; Isotype, NY, JDR).

NOTES: This seems to fit X. nodulosa Lloyd well except for smaller ascospores, i.e., the range above versus 32-38 X 8-9 µm. We have thus erected a small-spored variety. Miller's photograph (in my possession) of the Lloyd type indicates that it has long undulating ascospore germ slits. Our material has long spiralling germ slits.

Xylaria obovata (Berk.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3)1, p. 127. 1851. Figs. 47,49

Stromata more or less globose, ca. 1.5 cm diam, on short narrowed stipe; externally dull grey becoming black; internally white becoming hollow. Texture very hard. Surface smooth. Perithecia ca. 1 mm diam. Ostioles punctate. Asci not observed. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 23.5-29.5 X (6-) 6.5-7.5 µm, with slit short, oriented parallel to axis of spore or oblique to it.

SPECIMEN EXAMINED: S1507

NOTES: Our material is much as described by Dennis (1956), except that ascospores average somewhat longer, i.e. see above vs. 20-26 X 6-8.5 µm.

Xylaria cf. pallida Berk. & Cooke, J. Linn. Soc. Bot 15:395. 1876.

Stromata clavate on narrowed short stipes, up to 4 cm X 4 mm diam, externally at first white, then grey; internally white. Texture very hard. Surface smooth. Perithecia 0.3-0.5 mm. Ostioles punctate, inconspicuous. Asci eight-spored, cylindrical, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 3 µm high X 1.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 9-10.5 X 3.5-4.5 µm, with germ slit slightly less than spore-length.

SPECIMEN EXAMINED: S1165

NOTES: This fungus greatly resembles type material at (K). Our material was moldy and intact mature asci were lacking. This fungus has been known only from the type collection. Ascospores of our material are smaller than described by Dennis (1956), 10.5-12 X 4.5-5 µm.

Xylaria platypoda (Lév.) Fr. var. microspora J. D. Rogers & A. Y. Rossman, var. nov.

Figs. 18,19,22,48,50

Typical variety, Nova. Acta Regiae Soc. Sci. Upsal. (ser. 3)1, p. 127. 1851.

A varietate typica differt in ascosporis 26.5-32.5 X 9.5-10.5(-13.5) µm.

Differs from the typical variety in size of ascospores 26.5-32.5 X 9.5-10.5(-13.5) µm.

Stromata conic, up to 4 cm high X 7 mm diam, or subglobose or irregular, sessile, externally white with black ostioles and traces of orange at bases, internally white. Texture rather hard. Surface roughened by perithecial contours. Perithecia 1 mm or greater diam. Ostioles barely raised. Asci eight-spored, the spores sometimes arranged in partially biseriate manner, cylindrical to clavate, long-stipitate, 290-300 µm total length X 12-13 µm when spores uniseriate, X 15-20 when spores biseriate, the spore-bearing part 160-192 µm, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 5 µm high X 4.5 µm broad. Ascospores dark brown, often with tiny hyaline cell (primary appendage) at one end, ellipsoid-inequilateral to navicular, smooth, 26.5-32.5 X 9.5-10.5(-13.5) µm, with germ slit somewhat less than spore-length.

SPECIMEN EXAMINED: R2079 (Holotype, VEN; Isotype, NY, JDR).

NOTES: This fungus looks much like X. platypoda, but spores are much smaller than given by Dennis (1956), i.e., 36-50 X 12-15 µm. Joly (1968) erected var. patouillardii [as Xylosphaera platypoda (Lév.) Dennis var. patouillardii Joly] on material from Viet-Nam with slightly smaller ascospores and immersed, nonmammiform perithecia. Because Xylaria is conserved against Xylosphaera the following new combination is made: Xylaria platypoda (Lév.) Fr. var patouillardii (Joly) J. D. Rogers. Basionym: Xylosphaera platypoda (Lév.) Dennis var. patouillardii Joly, Rev. Mycologie 33:162. 1968.

Xylaria plumbea J. D. Rogers & G. J. Samuels, sp. nov.

Figs. 20,21,23,51,52

Stromata clavata, apicibus rotundatis vel acutis, stipitibus perangustis circa 1/3-1/2 longitudine toto, usque ad 3 cm X 3 mm diametrum, extus plumbea ostiolis nigris, intus alba. Textura durissima. Superficies levis praeter ostiola. Perithecia 0.4-0.5 diametro. Ostiola elevata, umbilicata vel aliquantum papillata. Asci octospori, cylindrici, longe stipitati, 145-160 µm longitudine tota X 5 µm crassi, partibus sporiferis 72-82 µm, annulo apicali in liquore iodato Melzeri immerso cyanescente, inverse petasiformi, 2 µm alto X 1.5 µm crasso. Ascosporae brunneae, unicellulares, longe ellipsoideo-inequilaterales vel naviculares vel allantoideae, leves, (10.5-)11-14(-15) X 3.5-4.5 µm, rima germinativa minus quam longitudine spora. Status anamorphosis ignotus.

Stromata clavate with rounded or acute apices, with narrowed stipes about 1/3 - 1/2 total length, up to 3 cm X 3 mm diam, externally lustrous grey with black ostioles, internally white. Texture very hard. Surface smooth except for ostioles. Perithecia 0.4-0.5 mm diam. Ostioles raised, umbilicate to somewhat papillate. Asci eight-spored, cylindrical, long-stipitate, 145-160 µm total length X 5 µm broad, the spore-bearing part 72-82 µm, with apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, 2 µm high X 1.5 µm broad. Ascospores brown, unicellular, long ellipsoid-inequilateral to navicular or allantoid, smooth, (10.5-)11-14(-15) X 3.5-4.5 µm, with straight germ slit somewhat less than spore-length.

SPECIMEN EXAMINED: S1814 (Holotype, VEN; Isotype, NY, JDR).

NOTES: This fungus was unknown to us. The stromatal surface is somewhat reminiscent of *X. dealbata*, but the color is more lustrous.

Xylaria schweinitzii Berk. & Curt., J. Acad, Nat. Sci. Philadelphia, N.S. 2:284. 1853.

Stromata clavate to highly irregular on abrupt narrowed stipe comprising 1/3-1/2 the total length, 5-6 cm high X 1-2.5 cm diam, externally dull black, internally white. Texture cheesy. Surface smooth or somewhat wrinkled. Perithecia ca. 1 mm diam. Ostioles discoid, tiny. Asci not intact; apical ring bluing in Melzer's iodine reagent, urn-shaped, 4.5-6 µm high X 3.5 µm broad. Ascospores brown, unicellular, ellipsoid-inequilateral to navicular, smooth, 23.5-31 X 6.5-7.5 µm, with slit much shorter than spore-length, oriented oblique to spore axis or spiralling.

Colonies on oatmeal agar at ca. 20 C under 12 h fluorescent light covering 9 cm diam Petri dish in 2-3 wk, at first velvety with large floccose sectors, white, uniform to faintly zonate, some with plumose margins, becoming tan to grey towards center then darkening to olive-black. Reverse tan with blackish centers. *Stromata* rudimentary, tuft-like, 1-5 mm tall X 1-2 mm diam, developing over surface but predominately at periphery of colonies, whitish, some becoming covered with a tan to dark grey layer. No conidiogenous structures produced.

SPECIMENS EXAMINED: S1158, S1310 (culture), S1704 (culture)

NOTES: *Xylaria schweinitzii* is a member of the *X. polymorpha* complex, along with *X. anisopleura* and *X. scruposa*. See notes on these latter two species herein. *Xylaria schweinitzii* and its anamorph have been discussed by Rogers & Callan (1986), but Venezuelan colonies yielded no anamorph.

Xylaria scruposa (Fr.) Fr., Nova Acta Regiae Soc. Sci. *Upsal.* (ser. 3) 1, p. 127. 1851; sensu Dennis, Kew Bull. 1956:436. 1956. Figs. 53,66

Stromata extremely variable, cylindrical to clavate, on short or long narrowed stipes, 3-5 cm total height X 2-7 mm diam; externally dull black, often with brown tones; internally white. Texture cheesy to hard. Surface often rugose with small wrinkles, sometimes corky. *Perithecia* 0.5-0.7 mm diam. Ostioles discoid, evident or obscure. *Asci* eight-spored, cylindrical, stipitate, 215-230 μm total length X 8-10 μm broad, the spore-bearing part 130-142 μm, with apical ring bluing in Melzer's iodine reagent, more or less urn shaped, 4.5-6 μm high X 3-4.5 μm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral, smooth, 16-23.5(-25) X (5-)6-7.5 μm, with germ slit shorter than spore-length, spiralling or oriented oblique to axis of spore.

Colonies on oatmeal agar at ca. 20C under 12 h fluorescent light covering 9 cm diam Petri dish in 2-3 wk, mycelium initially velvety with small floccose patches, zonate, white, then turning dusky rose, darkening to brownish grey towards center. Reverse pale brown. *Stromata* consisting of loosely compacted hyphal strands with expanded, cottony apices, 4-10 mm high X 2-4 mm diam at base, developing at periphery of colonies, white. No conidiogenous structures produced.

SPECIMENS EXAMINED: I462, R1897, R1982, R2057, R2059, R2405, R2538, S1211, S1229, S1918 (cultured).

NOTES: Xylaria scruposa is a complex taxon that seems particularly abundant in the American tropics. There are a number of nomenclatural problems with it, as discussed by Dennis (1956, 1958). Our concept of the species generally is that of Dennis. We consider it to be a member of the X. polymorpha (Pers.: Fr.) Grev. complex with ascospores that average smaller than those of X. schweinitzii and X. anisopleura, but grading into them.

Xylaria sp. (R1741) Figs. 54,55

Stromata cylindrical with sterile apex, geniculate from conspicuous widely-spaced ostioles, grading into stipes, 1.5 cm total length X 0.5-1 mm diam; externally brown, internally white. Texture soft. Smooth except for ostioles. Perithecia 0.1-0.2 mm diam. Ostioles strongly papillate. Asci eight-spored, cylindrical, 130 μm total length X 11 μm broad, the spore-bearing part 98 μm long, with apical ring bluing in Melzer's iodine reagent, somewhat urn-shaped, 7 μm high X 6 μm broad. Ascospores dark brown, unicellular, ellipsoid-inequilateral, smooth, 13.5-15 X 7.5-8 μm, with germ slit spore-length.

SPECIMEN EXAMINED: R1741

NOTES: This fungus might represent a new taxon, but our collection is too small to describe as such. It seems to resemble X. lima v. Höhnel (Saccardo, 1913), a species that we have not examined.

Xylaria sp. (R1965)

Stromata cylindrical to clavate, unbranched or several from common base, up to 4 cm long X 7 mm diam, with short stipes, externally dull black, internally white. Texture hard. Surface wrinkled and contorted. Perithecia 0.3 mm diam. Ostioles discoid. Asci probably eight-spored, cylindrical, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, rectangular, minute. Ascospores brown, unicellular, ellipsoid-inequilateral, smooth, 7.5-9 X 3.5-4.5 µm, with long germ slit.

SPECIMEN EXAMINED: R1965

NOTES: This fungus was unknown to us. It might eventually be shown to be a new species.

Xylaria sp. (R2023)

Stroma cylindrical with flattened areas and scattered naked perithecia, 1 cm long X 1 mm diam; externally black, internally white. Texture soft. Surface smooth except for perithecia. *Perithecia* 0.2 mm diam. Ostioles barely papillate. *Asci* eight-spored, cylindrical, 100-105 µm total length X 6-7 diam, with spore-bearing part 65-70 µm long, with apical ring bluing in Melzer's iodine reagent, more or less rectangular, 2 X 2 µm. *Ascospores* brown, unicellular, broad ellipsoid-inequilateral, smooth, 9-10.5 X 5-6 µm, with germ slit spore-length.

SPECIMEN EXAMINED: R2023

NOTES: This fungus was unknown to us. It is represented by only one stroma.

Xylaria sp. (R2072)

Stromata more or less cylindrical, on short stipes, up to 5 cm X 5 mm diam, externally dull black, but perhaps initially brown; internally white. Texture hard. Surface smooth except for major wrinkles, occasional perithecial elevations, and ostioles. *Perithecia* up to 1 mm diam. Ostioles papillate. *Asci* eight-spored, cylindrical, stipitate, 160 µm total length X 6 µm broad, the spore-bearing part 52 µm, with apical ring bluing in Melzer's iodine reagent, inverted hat-shaped, minute. *Ascospores* dark brown, unicellular, ellipsoid-inequilateral, smooth, 6.5-9 X 3.5-4.5 µm, with long, ill-defined germ slit.

SPECIMEN EXAMINED: R2072

NOTES: This fungus might represent a diminutive form of *X. cubensis*. Cultures of *X. cubensis* are highly characteristic (Rogers, 1984), but we were unable to culture this material. It resembles the description of *X. variegata* Sydow (H. & P. Sydow, 1907) in many respects and might be only a somewhat robust representative of that species.

Xylaria sp. (R2264) Figs. 56,57

Stromata clavate with acute apex, on short stipes, 2.5 cm high X 3 mm broad, externally rusty orange with black ostioles, internally yellow immediately beneath surface and white below. Texture rather soft. Surface finely wrinkled. *Perithecia* 0.5 mm diam. Ostioles barely papillate. *Asci* eight-spored, poor condition in this material, with apical ring bluing in Melzer's iodine solution, more or less urn-shaped, 4.5 μm high X 3 μm broad. *Ascospores* dark brown, unicellular, ellipsoid-inequilateral to navicular, smooth, 17.5-22 X 6.5-7.5 μm, with spiralling germ slit less than spore-length.

SPECIMEN EXAMINED: R 2264

NOTES: This fungus greatly resembles *X. phosphorea* Berk., but has much longer ascospores. Elongated anamorphic clubs were found associated with teleomorphs. Dennis (1956) remarked on a similar association in the case of *X. phosphorea* from Brazil. This fungus is probably to be considered as a large-spored variety of *X. phosphorea*, but the small size of the collection and the poor condition of asci constrain us from formally describing it.

Xylaria sp. (S1330)

Stromata upright, each stroma composed of rachis up to 6 cm X 0.5-1 mm bearing areas of naked perithecia, externally black, internally white. Texture rather soft. Surface roughened in perithecial areas. Perithecia 0.4-0.5 mm diam. Ostioles papillate. *Asci* eight-spored, poor condition in this collection, with apical ring bluing in Melzer's iodine reagent, urn-shaped, 6 μm high X 3 μm broad. *Ascospores* brown, unicellular, long ellipsoid-inequilateral to navicular, smooth, 22-25.5 X 6-7.5 μm, with germ slit straight to undulating, spore-length.

SPECIMEN EXAMINED: S1330

NOTES: Although the fungus is probably undescribed, this collection is too small to be the basis of a new species.

Xylaria sp. (S1353) Fig. 58

Stromata subglobose, ca. 2 mm diam, with narrow stipe up to 1.5 cm tall; externally, heads tan and stipes white; internally white. Texture soft. Surface smooth except for ostiolar papillae. Perithecia 0.3 mm diam. Ostioles papillate. Asci not present in this material. Ascospores nearly black, unicellular, very broad oval to nearly globose, inequilateral, smooth, 11-13 X 7.5-9 μm, with germ slit straight to undulate, spore-length.

SPECIMEN EXAMINED: S1353

NOTES: This fungus might represent a new taxon but our collection lacks asci and is too small to describe as new.

Xylaria sp. (S1364) Figs. 59,60

Stromata prostrate to partially upright, each stroma consisting of a rachis up to 30 cm long X 1 mm diam at attachment point to hair-like at apex, with individual naked perithecia scattered in areas up to 2 cm long at irregular intervals; externally black, internally white. Texture fairly hard. Surface smooth except for perithecial contours. Perithecia ca. 1 mm diam. Ostioles papillate. Asci eight-spored, cylindrical, poor condition in this material with ascus apical ring bluing in Melzer's iodine reagent, urn-shaped, 4.5 μm high X 3 μm broad. Ascospores dark brown, unicellular, strongly inequilateral, with abruptly narrowed or acute ends, smooth, 17.5-20 X 6.5-7.5 μm, with germ slit slightly less than spore-length.

SPECIMEN EXAMINED: S1364

NOTES: This fungus seems allied to X. juruensis P. Henn. and X. melanura (Lév.) Sacc. Ascospores are too large for the former fungus and too small for the latter. Moreover, the rachis is longer than reported for these species, as far as we are aware.

Xylaria sp. (S1836)

Stromata globose, up to 5 mm diam, on short stipes up to 5 mm long, externally ashen grey, internally white; stipe black. Texture very hard. Fertile parts smooth except for raised ostioles. Perithecia 1 mm or (+) diam. Ostioles umbilicate, raised. Asci eight-spored, cylindrical, stipitate, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, coffin-shaped, 14.5 µm high X 6 µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral, smooth, 29.5-37(-40) X (12-)13-15(-16) µm, with straight to undulating germ slit spore-length.

SPECIMEN EXAMINED: S1836

NOTES: This fungus was unknown to us. The small collection, the absence of intact mature asci, and the fact that stromata are moldy keep us from describing it as a new species.

Xylaria telfairii (Berk.) Fr., Nova Acta Regiae Soc. Sci. Upsal. (ser. 3) 1, p. 127. 1851. Fig. 61

Stromata clavate to cigar-shaped (fusoid) on narrowed stipe 1/4-1/3 the length of the fertile part, up to 5 cm total length X up to 1.2 cm diam; externally tan to light orange to reddish brown, internally white but becoming hollow and inrolled, often before maturation of perithecia. Texture hard to very hard. Surface smooth. *Perithecia* 0.5-0.7 mm diam. Ostioles umbilicate. *Asci* not intact; apical ring bluing in Melzer's iodine reagent, more or less urn-shaped, at least 4.5 µm high X 3 µm broad. *Ascospores* brown, unicellular, smooth, ellipsoid-inequilateral, (13-)17.5-25 X 6-7.5 µm, with germ slit short, oriented oblique to axis of spore.

SPECIMENS EXAMINED: R1979, R2096, R2145, R2199, S1355, S1562, S1706

NOTES: Most of our material is typical of *X. telfairii*, as discussed and illustrated by Dennis (1956). One collection -- R2199 -- differs from typical *X. telfairii* in having germ slits that are nearly spore-length. (See also discussion of *X. enterogena* elsewhere herein.)

Xylaria cf. *theissenii* Lloyd, Mycol. Notes 48, Mycol. Writ. 5:677. 1917. Figs. 62,63

Stromata clavate, up to 1 cm long X 3 mm diam, with short stipe and sterile acute apiculus, bearing more or less naked perithecia; externally black, internally white. Texture somewhat woody. *Perithecia* ca. 1 mm diam. Ostioles obscure. *Asci* not intact, with detached apical rings bluing in Melzer's iodine reagent, urn-shaped, 6 µm high X 3.5 µm broad. *Ascospores* dark brown, unicellular, ellipsoid-inequilateral, smooth, 22-26.5 X 6.5-7.5(-9.5) µm, with germ slit spore-length or slightly less than spore-length.

SPECIMEN EXAMINED: I594

NOTES: This fungus looks much like *X. theissenii* Lloyd, but lacks the long stalk of this species. It might prove to be only a morphological variant of that species.

Xylaria cf. *trichopoda* Penz. & Sacc., Icones fungorum javanicorum. p. 31. 1904.

Stromata consisting of a main axis with branches up to 5 cm X 1-1.5 mm diam bearing more or less naked perithecia on upper parts and extending beyond fertile region as sharp apices; externally blackish, internally white. Texture soft. Surface overall densely tomentose, the fertile parts roughened by perithecial contours. *Perithecia* 0.3-0.4 mm diam. Ostioles barely papillate. *Asci* eight-spored, cylindrical, poor condition in this material, with apical ring bluing in Melzer's iodine reagent, rectangular to inverted hat-shaped, 2 µm high X 2 µm broad. *Ascospores* brown, unicellular, ellipsoid-inequilateral, smooth, (10.5-)12-12.5 X 4.5-5 µm, with germ slit slightly less than spore-length.

SPECIMEN EXAMINED: S1342

NOTES: This fungus seems much like *X. trichopoda*, described originally from Java. The ascospores of our material average somewhat smaller than those from Java material, i.e., 11.5-14.5 X 5-6 µm as given by Dennis (1958) and 12-13.5 X 5 µm as given by Penzig and Saccardo (1904).

DATA ON CITED COLLECTIONS

Teresita Iturriaga (I) collections. All collections from VENEZUELA, Territorio Federal Amazonas.

Cerro de la Neblina base camp on Rio Mawarinuma, elev. 140 m, 00°50'N, 66°10'W: I104, 25-28 Nov 1984, on trunk; I115, 25-28 Nov 1984, on trunk; I127, 25-28 Nov 1984, on trunk; I407, 1-4 Dec 1984, on trunk; I462, 1-4 Dec 1984, on palm trunk; I501, 1-4 Dec 1984, on trunk.

Cerro de la Neblina massif, "Camp 7," elev. 1770-1850 m. Forested quebradas with *Euterpe* along river: I594, 29 Nov-1 Dec 1984, on wood.

A. Y. Rossman (R) collections. All collections from VENEZUELA, Territorio Federal Amazonas.

San Carlos de Rio Negro, near airport, on IVIC plot, 5 Jan 1985: R1736, on dead branch; R1740, on legume pod (*Elizabetha* sp.); R1741, on leaves.

Cerro de la Neblina base camp, on Rio Mawarinuma, left bank, elev. 140 m, 00°50'40"N, 65°58'10"W: R1766, 27 Jan 1985, on pod of legume (*Elizabetha* sp.); R1772, on pod of legume (*Elizabetha*); R1785, 27 Jan 1985, on log; R1794, 28 Jan 1985, on log; R2380, 27 Jan 1985, on decaying leaf of Alusiaceae; R2394, 27 Jan 1985, on thin leaf; R2405, 27 Jan 1985, on wood; R2425, 28 Jan 1985, on wood; R1955, 05 Feb 1985, on log; R1965, 04 Feb 1985, on log; R1979, 05 Feb 1985, on log; R1982, 06 Feb 1985, on log; R1986, 06 Feb 1985, on wood; R1987, 03 Feb 1985, on log; R2003, 06 Feb 1985, on wood; R2004, 06 Feb 1985, on wood; R2009, 11 Feb 1985, on wood; R2010, 11 Feb 1985, on tree fern stump; R2023, 11 Feb 1985, on leathery leaf; R2035, 11 Feb 1985, on wood; R2043, 12 Feb 1985, on log; R2057, 11 Feb 1985, on wood; R2059, 12 Feb 1985, on log; R2064, 12 Feb 1985, on wood; R2068, 11 Feb 1985, on wood; R2072, 11 Feb 1985, on log; R2079, 03 Feb 1985, on wood; R2085, 12 Feb 1985, on log; R2096, 11 Feb 1985, on wood; R2143, 18 Feb 1985, on log; R2145, 18 Feb 1985, on log; R2155, 18 Feb 1985, on log surrounded by termite nest; R2164, 18 Feb 1985, on small dead twigs; R2192, 20 Feb 1985, on wood, R2199, 21 Feb 1985, on wood; R2224, 24 Feb 1985, on leaf.

Cerro de la Neblina, 6.2 km NNE Pico Phelps, elev. 1390-1515, 00°51'45"N, 65°58'52"W: R2233, 24 Feb 1985, on *Clusia* sp.; R2264, 24 Feb 1985, on *Clusia* sp.; R2296, 23 Feb 1985, on dead twig; R2309, 23 Feb 1985, on wood.

Cerro de la Neblina, 51 km NE Pico Phelps, elev. 1730-1850, 00°50'40"N, 65°58'10"W: R1979, 05 Feb 1985, on log; R2470, 02 Feb 1985, on log; R2483, 03 Feb 1985, on palm trunk; R2515, 03 Feb 1985, on log; R2517, 03 Feb 1985, on dead limb; R2538, 03 Feb 1985, on wood.

G. J. Samuels, et al. (S) collections. All collections from VENEZUELA, Territorio Federal Amazonas.

Rio Negro, San Carlos de Rio Negro, dry forest on sand, elev. 140 m: S1353, 9 Apr 1984, on decaying leaf of *Clusia* sp.

Cerro de la Neblina base camp, on Rio Mawarinuma, elev. 140 m, 00°50'40"N, 65°58'10"W: S1158, 10 Apr 1984, on wood; S1159, 10 Apr 1984, on ?legume fruit; S1165, 10 Apr 1984, on wood; S1168, 10 Apr 1984, on wood; S1173, 10 Apr 1984, on Clusia fruit; S1183, 10 Apr 1984, on wood; S1355 19 Apr 1984, on wood; S1410, 20 Apr 1984, on Ficus leaves; S1425, 20 Apr 1984, on wood; S1427, 20 Apr 1984, on wood; S1432, 20 Apr 1984, on wood; S1450, 20 Apr 1984, on wood; S1451, 20 Apr 1984, on wood, S1455, 20 Apr 1984, on wood; S1458, 20 Apr 1984, on wood, S1468, 21 Apr 1984, on wood; S1484, 21 Apr 1984, on wood; S1530, 22, 23 Apr 1984, on ?legume fruit; S1542, 22, 23 Apr 1984, on log; S1562, 22, 23 Apr 1984, on wood, S1568, 22, 23 Apr 1984, on log; S1918, 1984; S1926, 7 May 1984, on dead tree.

Cerro de la Neblina, "Camp 5", valley N base of Pico Phelps, elev. 1000-1250 m, 00°49'N, 66°0'W, cloud forest: S1189, 12 Apr 1984, on ?legume fruit; S1206, 12 Apr 1984, on wood; S1207, 12 Apr 1984, on wood; S1210, 12 Apr 1984, on wood; S1211, 12 Apr 1984, on wood; S1229, 12 Apr 1984, on wood; S1330, 12 Apr 1984, on petiole of Cercropia; S1342, 12 Apr 1984, on soil; S1346, 12 Apr 1984, on bark.

Same data as above, except elev. 1350 m: S1257, 13,14 Apr 1984, on wood; S1264, 13,14 Apr 1984, on wood; S1310, 13,14 Apr 1984, on wood.

Cerro de la Neblina, "Camp 6", ridge at Venezuela-Brazil divide, ca. 3.5 km W of Pico Zoloaga, 26 km ENE of base camp, elev. ca. 2000 m, 00°53'N, 65°15'W, intermittent cloud forest with Clusia spp. and Melastomaceae and bromeliad ground cover: S1364, 15, 16 Apr 1984, on leaves, wood.

Cerro de la Neblina, ca. 0.5 km walk on trail leading S of base camp, elev. ca. 140 m, periodically inundated forest: S1507, 22 Apr 1984, on wood; S1521, 22 Apr 1984, on wood.

Cerro de la Neblina, "Puerto Chimo," ca. 5 km upstream from base camp, elev. 300-500 m, dry upland forest: S1618, 25 Apr 1984, on wood.

Cerro de la Neblina, vic. base camp, trail leading upstream along tributary of Rio Mawarinuma, elev. 140 m, periodically inundated forest: S1698, 28 Apr 1984, on wood; S1704, 28 Apr 1984, on wood; S1706, 28 Apr 1984, on wood.

Cerro de la Neblina, vic base camp, ca. 3 km upstream on Rio Mawarinuma, elev. ca. 140 m, periodically inundated forest of Phenakospermum, palms, and bamboo: S1768, 1,2 May 1984, on wood; S1801, 1,2 May 1984, on forest litter.

Cerro de la Neblina, on trail leading E from Rio Mawarinuma opposite base camp, elev. ca. 140 m, periodically inundated forest grading into dry upland forest: S1814, 3 May 1984, on wood; S1818, 3 May 1984, on wood.

Cerro de la Neblina, vic base camp, study plot 5 min SE base camp, elev. ca. 140 m, moist forest dominated by legume trees: S1836, 4 May 1984, on wood; S1839, 4 May 1984, on wood.

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THREE NEW SPECIES OF *PARMELIA* (LICHENES) FROM SOUTHERN AFRICA

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ABSTRACT

Three new species of *Parmelia* (Lichenes, Parmeliaceae) are described from southern Africa. They are: *Parmelia asilaris* Brusse, *P. lurida* Brusse and *P. spissa* Brusse. Their chemistries and affinities are discussed.

PARMELIA ASILARIS Brusse, *sp. nov.*

Thallus foliosus, saxicola, ad 8 cm diametro, sat vel arcte adnatus. *Lobi* elongati, 0,5–3,5 mm lati, 100–250 µm crassi. *Thallus superne* leviter cinereus, nitidus, isidiis sorediisque destitutus. *Cortex superior* 10–13 µm crassus. *Stratum gonidiale* 20–50 µm crassum, algis *Trebouxiis*, 4,5–16 µm diametris. *Medulla* alba, 65–180 µm crassa. *Cortex inferior* 6,5–8 µm crassus. *Thallus inferne* piceus. *Rhizinae* simplices, 45–70 µm crassae. *Apothecia* ad 5 mm diametris. *Hypothecium* hyalinum, 15–40 µm crassum. *Subhymenium* hyalinum, 5–10 µm crassum. *Hymenium* hyalinum, 45–55 µm altum, J+ caeruleum. *Asci* clavati, tholis J+ caeruleis (fig. 1). *Ascosporae* octonae, hyalinae, simplices, ellipsoideae, 8–10,5 x 4,5–6 µm. *Pycnidia* globosa, 100–150 µm profunda, 100–120 µm lata. *Pycnidiosporae* aciculares, hyalinae, rectae, 4,5–7,5 x 0,8 µm. *Thallus* atranorinum, acidum sticticum et acidum constictícum continens.

TYPUS: SOUTH AFRICA, Cape Province, Mountain Zebra National Park near Cradock, Bankberg mountains, on dolerite outcrop on E slope, near ascending road from rest camp to Rooiplaat, alt. 1280 m. *F. Brusse 4680*, 29.i.1986 (PRE, holo-; LD, iso -). Fig. 3.

Thallus foliose, saxicolous, to 8 cm across, moderately to tightly adnate. *Lobes* elongate, 0,5–3,5 mm broad, 100–250 µm thick. *Upper surface* light grey, nitid, not isidiate and not sorediate. *Upper cortex* 10–13 µm thick. *Algal layer* 20–50 µm thick, algae *Trebouxia*, 4,5–16 µm diam. *Medulla* white, 65–180 µm thick. *Lower cortex* 6,5–8 µm thick. *Lower surface* black. *Rhizines* simple, 45–70 µm thick. *Apothecia* to 5 mm diam. *Hypothecium* hyaline, 15–40 µm thick. *Subhymenium* hyaline, 5–10 µm thick. *Hymenium* hyaline, 45–55 µm high, J+ blue. *Asci* clavate, eight-spored, tholus J+ blue (fig. 1). *Ascospores* hyaline, simple, ellipsoid, 8–10,5 x 4,5–6 µm. *Pycnidia* globose, 100–150 µm deep, 100–120 µm wide. *Pycnidiospores* hyaline, straight needles, 4,5–7,5 x 0,8 µm. *Chemistry*: Atranorin in the cortex, stictic and constictic acids in the medulla.

This new species is most similar to *Parmelia (Canoparmelia) inhaminensis* Dodge, with the same combination of characters commonly used in *Parmelia*. However, *P. inhaminensis* is a corticolous lichen of tropical areas in Africa, perhaps restricted to low lying coastal areas, whereas *P. asilaris* occurs in an arid temperate area on rock, where winters get relatively cold. Although several corticolous species (i.e. *Canoparmelias*, see Elix, Johnston & Verdon (1986)) are known to grow on rock, they are then fairly loosely adnate, because they are actually growing on the plant debris that has accumulated under them, if not present over the rest of the rock. *P. asilaris* is moderately tightly adnate on rock, and is not growing over plant debris.

The ascospores of *Parmelia asilaris* are somewhat smaller (8–10,5 x 4,5–6 µm) than those of *P. inhaminensis* (10–12 x 5–8 µm), and the pycnidiospores are somewhat shorter too (4,5–7,5 µm long in *P. asilaris* as opposed to about 12 µm long in *P. inhaminensis*. Hale 1976). *P. asilaris* resembles the common Cape *Paraparmelia, Parmelia molybdiza* Nyl., but the medulla is K+ yellow instead of C+ red.

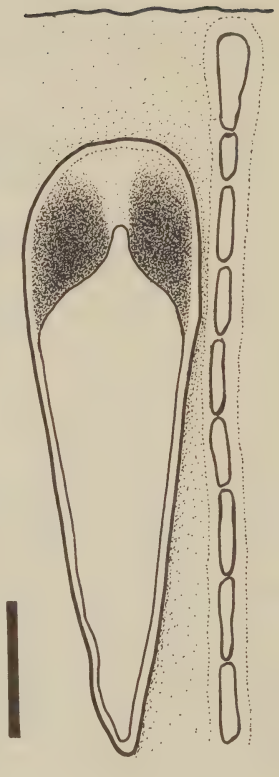

Fig. 1. *Parmelia asilaris* Brusse, ascus and paraphysis. *F. Brusse 4680*, holotype. Bar = 10 µm.

The isidiate counterpart of *P. asilaris* may be *P. ischnoides* Kurok., which is still only known from the Cape peninsula, with somewhat narrower lobes than *P. asilaris*.

The typification of the genus *Parmelia* remains problematical, because the genus was first satisfactorily typified by *P. conspersa* Ach. by Clements & Shear in 1931. This typification must be followed (Art. 8, Voss 1983) keeping in mind that the type is not necessarily the most typical or representative element of a taxon (Art. 7.2), and that sections of genera have no priority outside of their own rank (Art. 11), and therefore cannot be used to determine the types of genera. This latter procedure was used by Berry (1941) to choose *P. saxatilis* (L.) Ach. as type. This was later followed by the Special Committee for Lichens of the Paris Congress (Ahlner 1954), for reasons not given, but presumably because of the intention to conserve *Parmelia* against *Lichen*. In my opinion, the name *Lichen* was unsatisfactorily typified by the Special Committee for Lichens of the Paris Congress (Ahlner 1954), as *Lichen saxatilis*, because it contradicts a previously satisfactorily determined type, *Parmelia conspersa* Ach. (Clements & Shear 1931), when conserved against *Parmelia. Lichen* should be typified by an original species, which when rejected against it's genus, should not interfere with the earliest satisfactory typification, already extant.

Although all editions of the Botanical Code of Nomenclature since the Paris Code (Lanjouw 1956), list *Lichen* as rejected against *Parmelia*, this is in fact in error. Article 15 of the Code requires that each name proposed for conservation, be ratified three (3) times — firstly, by a Special Committee for the taxonomic group concerned; secondly, a General Committee; and lastly, a general assembly of an International Botanical Congress, respectively. Most of the lichen names currently listed as conserved, were only approved by the Special Committee for Lichens of the Paris Congress (Ahlner 1954). This committee processed the longer list of proposals submitted to the Cambridge Congress by Zahlbruckner (Briquet 1930, 1935) which was passed-on to the Amsterdam Congress (Camp *et al*. 1947). This list, which included a superfluous proposal to conserve *Parmelia* against *Imbricaria* (not *Lichen*), was not acted on by these congresses, and is not mentioned at all in the Stockholm Code (Lanjouw 1952). There is no evidence, that the list processed by the Special Committee for Lichens of the Paris Code (Ahlner 1954), went any further at that Congress (*Taxon* **3**: 233 (1954); *Taxon* **4**: 162–164 (1955)), and I have been unable to trace any indication of this at any later Congress. *Parmelia* Ach. is therefore not really conserved against *Lichen* L., as it presently stands in the Code.

Parmelia, typified by *P. conspersa* Ach. (Clements & Shear 1931), can be used for a far larger number of species than it could were it typified by *P. saxatilis*, which would then leave the literature as little altered as possible.

To my mind the *Parmelia saxatilis* group may be more closely allied to the Cetrarioid lichens, because of the presence of a syncortex rather that an epicortex (Modenesi & Vanzo 1986), but this work is very preliminary at present. If the present family Parmeliaceae is split further in the future, then the *P. saxatilis* group might belong to the Cetrariaceae (Schaerer 1850, Cooke & Hawksworth 1970), rather than a more restricted Parmeliaceae. It would be more preferable to retain most of the species, previously placed in *Parmelia*, in a future more restricted Parmeliaceae.

The use of the name *Parmelia* for the *P. saxatilis* group, is therefore unacceptable to me, and I continue to use *Parmelia* in a broad sense, until more pertinent morphological data becomes available, and until the nomenclature is clarified.

At present *P. asilaris* is known only from the type locality, the Bankberg near Cradock, in a game reserve created to preserve the Mountain Zebra (*Equus zebra* L. subsp. *zebra*).

PARMELIA LURIDA Brusse, *sp. nov.*

Thallus foliosus, saxicola, appressus, ad 2 cm diametro. *Lobi* elongati vel sublineares, 0,1–1,2 mm lati, 95–140 µm crassi. *Thallus superne* luteolus vel pallide helvolus, emaculatus, nitidus, isidiis sorediisque nullis. *Cortex superior* 10–15 µm crassus. *Stratum gonidiale* 12–40 µm crassum, algis *Trebouxiis*, 4,0–16,5 µm diametris. *Medulla* alba, 45–90 µm crassa. *Cortex inferior* 6–13 µm crassus. *Thallus inferne* piceus. *Rhizinae* sparsae, 80–100 µm crassae. *Apothecia* et *Pycnidia* non visa. *Thallus* materias ignotas continens.

TYPUS: SOUTH AFRICA, Cape Province, 19 km S of Prince Albert, summit of Swartberg Pass, wind blown SE gulleys, on S faces of TMS rocks in more exposed positions, alt. 1650 m, *F. Brusse 4889*, 7. ii. 1986 (PRE, holo-). Fig. 4.

Thallus foliose, saxicolous, appressed, to 2 cm across. *Lobes* elongate to sublinear, 0,1–1,2 mm broad, 95–140 μm thick. *Upper surface* pale yellowish, emaculate, nitid, non-isidiate and non-sorediate. *Upper cortex* 10–15 μm thick. *Algal layer* 12–40 μm thick, algae *Trebouxia*, 4,0–16,5 μm diam. *Medulla* white, 45–90 μm thick. *Lower cortex* 6–13 μm thick. *Lower surface* black. *Rhizines* sparse, 80–100 μm thick. *Apothecia* and *Pycnidia* not seen. *Chemistry*: an unidentified pale yellow substance in the cortex, and another colourless one in the medulla.

Parmelia lurida is one of the few species that do not contain either usnic acid, lichexanthone, or atranorin/chloroatranorin in the cortex. This new species is related to *P. chapadensis* Lynge from the Mato Grosso of Brazil, but has a black lower surface, instead of a pale brown one, as in *P. chapadensis* (Hale 1976, Lynge 1914). The unidentified substance in the medulla is colourless, KC+ rose, and fluoresces white in longwave ultraviolet light, whereas that in *P. chapadensis* is P+ red (Hale 1976). The cortical pigment appears as a dark spot on TLC plates in longwave ultra-violet light, reacts similarly to usnic acid with 10% sulphuric acid and heat, but is paler yellow and has slightly different R_f values than usnic acid on TLC plates, run according to the method of Culberson (1972) and Culberson & Johnson (1982).

Parmelia lurida is presently known only from the type locality at high altitude in the Swartberg range, near Oudtshoorn.

PARMELIA SPISSA Brusse, *sp. nov.*

Thallus subcrustosus, basalticola, ad 4 cm diametro. *Lobi* elongati, ad 4 mm longi, 0,3–1,2 mm lati, 140–330 μm crassi. *Thallus superne* flavo-viridis, emaculatus, ad apicem loborum versus pruinosus, isidiis sorediisque nullis. *Cortex superior* 13–30 μm crassus, paraplectenchymatus, cellulis 3–6 μm diametris. *Stratum gonidiale* 45–60 μm crassum, algis *Trebouxiis*, 4–15 μm diametris. *Medulla* alba, 50–240 μm crassa. *Cortex inferior* 5–20 μm crassus. *Thallus inferne* pallidus. *Rhizinae* non bene evolutae. *Apothecia* sessilia vel adnata, ad 1,5 mm diametris. *Hypothecium* hyalinum, 45–65 μm crassum. *Subhymenium* hyalinum, 4,5–6,5 μm crassum. *Hymenium* hyalinum, 45–55 μm altum, J+ caeruleum. *Asci* clavati, tholis J+ caeruleis (fig. 2). *Ascosporae* octonae, simplices, hyalinae, ellipsoideae, 8–10,5 × 4,5–6 μm. *Pycnidia* globosa, 160–230 μm profunda, 120–140 μm lata. *Pycnidiosporae* hyalinae, rigidae, aciculares, 7,5–11,5 × 0,8 μm. *Thallus* acidum usnicum, acidum evernicum et acidum lecanoricum continens.

TYPUS: SOUTH AFRICA, Natal, 31 km S of Phuthaditjhaba (Witsieshoek), Mont-aux-Sources, summit plateau of Western Buttress, on S faces of basalt rocks in dry exposed positions, on gentle S slope, alt. 3080 m, *F. Brusse 4524*, 21. i. 1986 (PRE, holo-; LD, iso-). Fig. 5.

Thallus subcrustose, basalticolous, to 4 cm across. *Lobes* elongate, to 4 mm long, 0,3–1,2 mm broad, 140–330 μm thick. *Upper surface* yellow-green, emaculate, pruinose towards lobe ends, non-isidiate and non-sorediate. *Upper cortex* 13–30 μm thick, paraplectenchymatous, cells 3–6 μm diam. *Algal layer* 45–60 μm thick, algae *Trebouxia*, 4–15 μm diam. *Medulla* white, 50–240 μm thick. *Lower cortex* 5–20 μm thick. *Lower surface* pale. *Rhizines* not well developed. *Apothecia* sessile to adnate, to 1,5 mm diam.

Hypothecium hyaline, 45–65 µm thick. *Subhymenium* hyaline, 4,5–6,5 µm thick. *Hymenium* hyaline, 45–55 µm high, J+ blue. *Asci* clavate, eight-spored, tholus J+ blue (fig. 2). *Ascospores* simple, hyaline, ellipsoid, 8–10,5 x 4,5–6,0 µm. *Pycnidia* globose, 160–230 µm deep, 120–140 µm wide. *Pycnidiospores* hyaline, rigid needles, 7,5–11,5 x 0,8 µm. *Chemistry*: Usnic acid in the cortex, evernic and lecanoric acids in the medulla.

This new species was at first thought to be *Parmelia scitula* Brusse (1984), but a careful study of the chemistry revealed the additional presence of evernic acid in the medulla. The lobes become much thicker in *P. spissa* (to 330 µm), than in *P. scitula* (to 150 µm), and *P. spissa* is so far known only from high altitude basalt in the Drakensberg, whereas *P. scitula* occurs in the southern Cape mountains to southern Natal at moderate altitudes. The quantitative measurements of the two species vary somewhat from each other, but it is not yet known if this is really significant, as relatively few specimens of each species have been examined. The upper cortex of *P. spissa* is, however, more dense and paraplectenchymatous, than the fairly loose palisade plectenchyma, normal for most of the genus *Parmelia* except the *P. saxatilis* group, the brown Parmeliae, and the *P. reticulata* group.

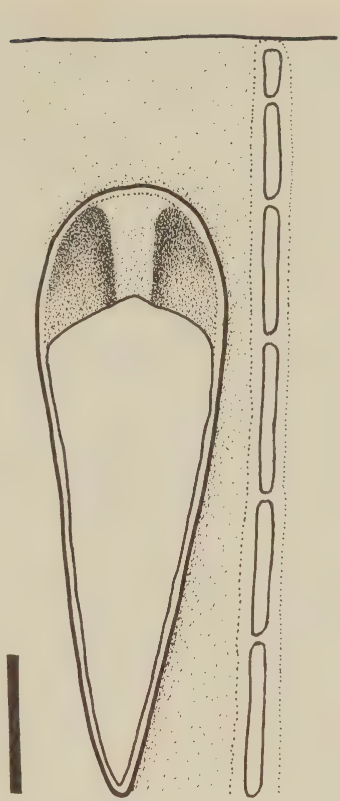
Fig. 2. *Parmelia spissa* Brusse, ascus and paraphysis. *F. Brusse 4524*, holotype. Bar = 10 µm.

This new species is presently known from the type locality, the summit plateau of the Western Buttress of Mont-aux-Sources, in the Royal Natal Park, and from Naudé's Nek further south.

SOUTH AFRICA, Natal — 2828 (Bethlehem): Mont aux Sources, near Hut, alt. 9,900', lithophytic on basalt boulders, exposed, succeeding crustose species, frequent (–DD), *E. Schelpe 1293*, 17. ii. 1946 (NU).

Cape—3028 (Matatiele): 65 km N of Maclear, summit of Naudé's Nek, basalt summit plateau near SE cliff edge, on basalt rocks in full sun, alt. 2500 m (–CA). *F. Brusse 4592*, 26.ii.1986 (BM, COLO, LD, PRE).

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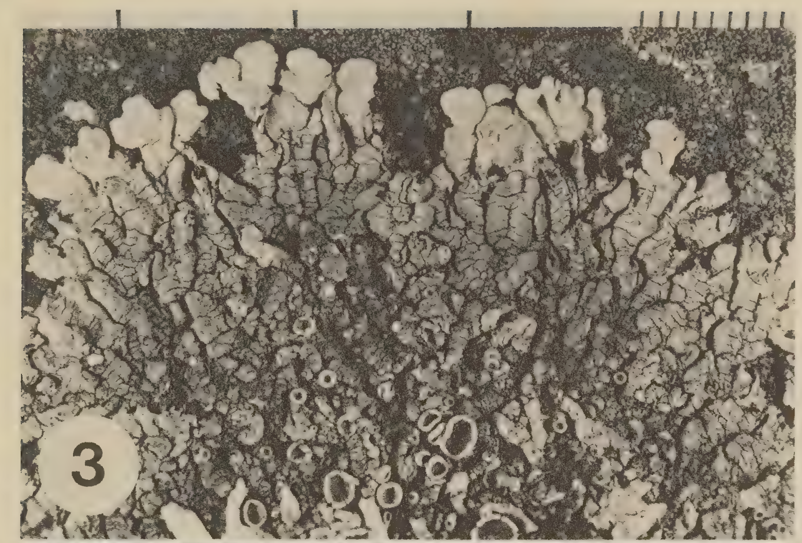
FIGURE 3. *Parmelia asilaris* Brusse, habit. *F. Brusse 4680*, holotype. Scale in mm.

FIGURE 4. *Parmelia lurida* Brusse, habit. *F. Brusse 4889*, holotype. Scale in mm.

FIGURE 5. *Parmelia spissa* Brusse, habit. *F. Brusse 4524*, holotype. Scale in mm.



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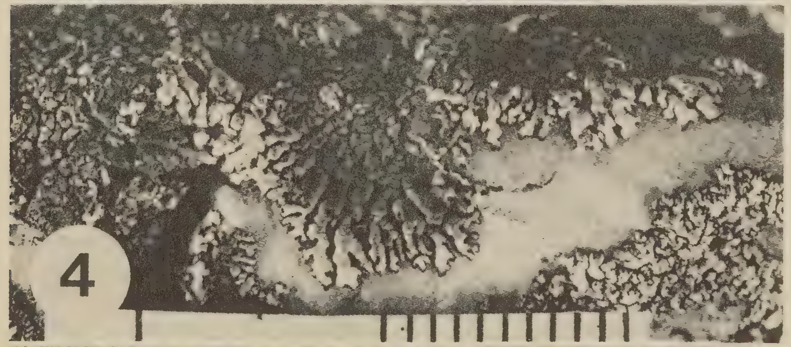

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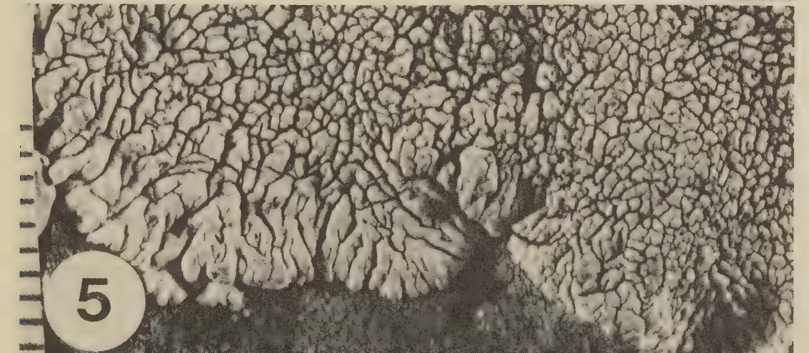

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CIRRENALIA BASIMINUTA: A NEW LIGNICOLOUS MARINE DEUTEROMYCETE FROM THE TROPICS

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During our examination of mangrove and submerged wood for marine fungi an underscribed species of *Cirrenalia* was encountered. Ten *Cirrenalia* species have been described; five from the marine environment (*C. fusca, C. macrocephala, C. pseudomacrocephala, C. pygmea, C. tropicalis*) and five from terrestrial habitats (*C. donnae, C. lignicola, C. indica, C. japonica, C. palmicola*)(Goos, 1985). The new fungus was collected on mangrove wood from Goa and from test blocks submerged in the sea at Kuwait (Zainal and Jones, 1984, 1986).

CIRRENALIA BASIMINUTA Raghu-Kumar et Zainal sp. nov. (Figs. 1-10).

Hyphae 2.4-5.0µm diametro, septatae, hyalinae vel pallido-brunneae. *Conidiophora* terminalia, monoblastica, 8.2-28.1 x 1.4-2.5µm. *Conidia* acrogena, solitaria, helicoidea, semicontorta, 29-41µm alta, 18-34µm diametro, 3-4 (-5) septata, constricta ad septa. Cellula apicalis 9.4-16.2 x 9.0-13.7µm, subglobosa, cellula ad basim attenuata, 4.9-17µm longa, 2.5-7.0µm diametro.

Substratum: lignum immersum *Rhizophorae mucronatae* et *Pini sylvestris*.

Holotypus: in laminis vitreis et culturis ex ligno immerso *Pini sylvestris*, IMI. 318783.

Isotypus: cultura ex *Rhizophora mucronata* (2/10/86).

CIRRENALIA BASIMINUTA Raghu-Kumar et Zainal

Hyphae: 2.4-5.5µm in diameter, septate, hyaline to pale brown. *Conidiophores* terminal, integrated, monoblastic and determinate, 8.2-28.1 x 1.4-2.5µm. *Conidia* borne acrogenously, rarely borne laterally, and directly on conidiophore, solitary, helicoid, semi-contorted, 29-41µm high and 18-34µm in diameter. *Conidia* 3-4 (5) septate, constricted at the septa. Cells increasing in size from base to apex. Apical cell 9.4-16.2 x 9.0-13.7µm subglobose basal cell cylindrical and tapering, 4.9-17.1µm long and 2.5-7.0µm wide at the widest part. Pigmentation of the cells increasing from base to apex, the apical cell light brown with a reddish tinge.

Holotype: Slides and cultures isolated from submerged test block at Doha, Kuwait, January 1984, IMI. 318783.

Isotype: Cirrenalia basiminuta culture isolated from *Rhizophora mucronata* Lank. 2nd October 1983 from mangroves at Orda, Goa, India.

Etymology: from the latin *basim*-base, and *minuta* - small referring to the small basal cell of the condium.

Conidial measurements of Kuwait material on wood blocks were 13.6 (15.8) 17µm high and 14-18µm diameter while the basal cell is the smallest, 10-14µm long and 5-7µm wide. The conidia from the culture material (Goa) being slightly larger.

The conidium initial arises as an apical, club-shaped swelling of the conidiogenous cell which is then cut off by the septum. This cell increases in size and the rest of the septa are then formed. The young conidium enlarges the apical cell attains its characteristic shape and darkens in colour and is usually the darkest.

C. basiminuta most closely resembles *C. pseudomacrocephala;* however, the latter has conidia that are less constricted, darker and usually have more septa (3-6). *C. fusca* has a more reniform or ellipsoidal apical cell and is thus quite distinct from *C. basiminuta*. *C. pygmea* has very dark brown conidia and a characteristic apical cell which is much larger than that of *C. basiminuta*. *C. basiminuta* differs from all the other marine *Cirrenalia* species in conidial dimensions, septation, degree of coiling and constriction at the septa and the conidia are paler in colour (see Table 1 after Kohlmeyer and Kohlmeyer, 1979; Goos, 1985). Also the basal cell is quite characteristic and is peg-like in appearance.

The genera *Zalerion* and *Cirrenalia* are similar in morphology. The latter has conidia that are brown to fuscous in colour (fuscous in *Zalerion*), the apical cell diameter is greater than the other cells and the conidia are less coiled than those of *Zalerion*. This raises the question of the placement of the terrestrial species, because these have apical cells that are generally the same diameter as the remaining cells and are many times more septate (up to 12 septa).

Teleomorphs have not been found for any species of *Cirrenalia*. Nakagiri (1984) demonstrated that *Lulworthia uniseptata* is the teleomorph of *Zalerion maritimum*.

There seems to be a blurring of the taxonomic criteria for the separation of these genera; particularly with the inclusion of species such as *C. donnae* and *C. lignicola* (Sutton, 1973; Kirk, 1981). Sutton (1973) broadened the generic description because he believed that a distinctive feature of *Cirrenalia* is that the "apex of the conidiogenous cells and basal cell of the conidium are both at the centre of the helix formed by the conidial filament, whereas in other helicosporous fungi such as *Helicosporium* and *Helicoma* they are formed on the periphery of the helix". Sutton (1973) has ignored the most distinctive feature of the genus, namely that the diameter and pigmentation of the conidia increase from the base to the apex of the conidium (Meyers and Moore, 1960; Kohlmeyer and Kohlmeyer, 1979).

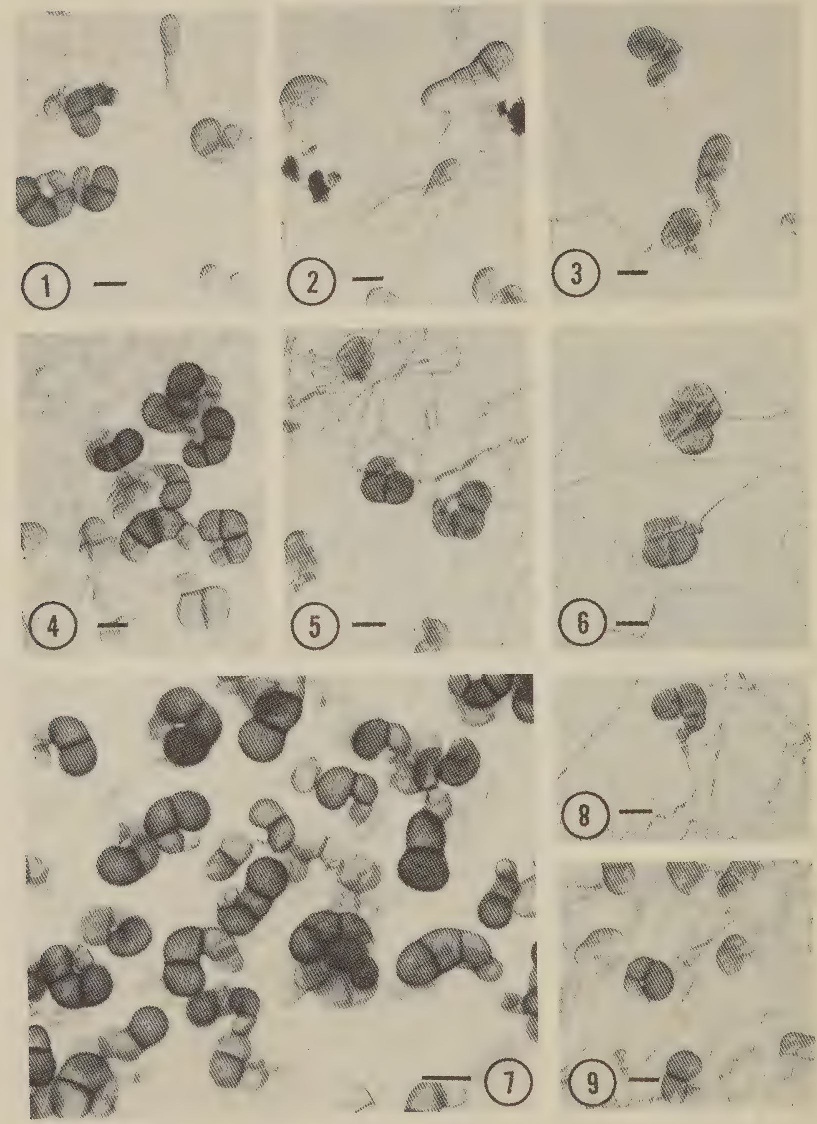
We concur with the views of Goos (1985) that the genus *Cirrenalia* is a heterogenous assemblage of species. For this reason we would exclude: *C. donnae*, *C. lignicola*, *C. japonica (?)* and *C. palmicola* from *Cirrenalia*. However, for the present, the terrestrial species are best left in *Cirrenalia*, until further studies are undertaken.

TABLE I. CONIDIAL MEASUREMENTS (μ) OF *CIRRENALIA* SPECIES

Species	Conidiophore size	Degree of Coiling	Conidia	Terminal cell	Morphology	Septation	Distribution	Conidiophore	Reference
Marine *C. fusca* Schmidt.	up to 23(33) x 3-6	$1^{1}/2$	20-36 high	13-33 high	reniform to ellipsoidal sausage-shaped	2-4	Temperate	Micro-nematous	Schmidt 1969
C. macrocephala (Kohlm.) Meyers & Moore	3.5-25 x 2-5	$^{1}/4$-1	12-35 high 12-23.5 diam. reddish brown	5.5-13.5 high 6.5-17 diam.	subglobose	2-7	Cosmopolitan	semi-macro-nematous	Kohlmeyer & Kohlmeyer 1979
C. pseudomacrocephala Kohlm.	23-30 x 3-5	$1^{1}/4$	27.5-38.5 diam. brown	16.5-18.5 high 16.5-20 diam.	subglobose to ellipsoidal	3-6	Tropical?	semi-macro-nematous	Kohlmeyer & Kohlmeyer 1979
C. pygmea Kohlm.	lacking	$^{1}/2$-1	25.5-31 28.5-34 black shiny	16.5-23 diam.	reniform	3-4	Tropical	-----	Kohlmeyer & Kohlmeyer 1979
C. tropicalis Kohlm.	25-42 x 2.5-5.5	1-$1^{1}/2$	20-38.5 diam. brown	9-15 high 10-20 diam.	subglobose to ellipsoidal	6-12 slightly constricted at septa	Tropical	macro-nematous	Kohlmeyer & Kohlmeyer 1979
C. basiminuta	8.2-28.0 x 1.4-2.5	$^{1}/2$	29-41 high 18-34 diam. pale brown	9.4-16.2 x 9.0-13.7	subglobose	3-5	Tropical?	-----	

TABLE I. Cont'd

Species	Conidiophore size	Degree of Coiling	Conidia	Terminal cell	Morphology	Septation	Distribution	Conidiophore	Reference
Terrestrial									
C.donnae Sutton	up to 35 x 3-6	1	20-25.5 diam. reddish brown	10 wide	Globose	7-11	Temperate	Sporodochial	Sutton 1973
C.indica Rao & Reddy	6-9 x 3-6	$^{1}/4-{}^{1}/2$	10-15 diam. subhyaline/dark brown	-----	Large variable in shape	-----	-----	-----	Rao & Reddy 1978
C.japonica Sugiyama	63 x 2.5 x 6	$^{1}/2-1$	18-28 diam. reddish brown	-----	Rounded slightly swollen	4-9	?	Fasciculate	Sugiyama 1981
C.lignicola Kirk	Indeterminate	$1^{1}/2-2$	15-20 diam. oliveaceous brown	-----	Rounded	up to 12	Temperate	Micronematous	Kirk 1981
C.palmicola Matsushima	-? x 1-2.5	1-3	5-8 x 40-100 dark brown	-----	Rounded	10-30	Tropical	Micronematous	Matsushima 1980



Figs. 1-9. Light micrographs of *Cirrenalia basiminuta*. Stages in the development of conidia. Bar lines = 10μm.

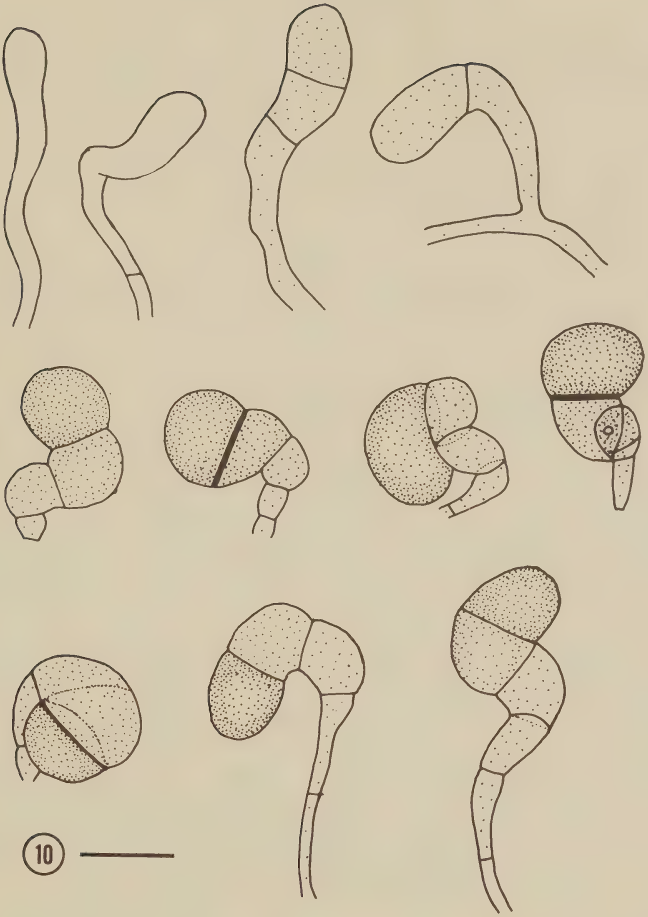


Fig. 10. Line drawings of conidial development in *Cirrenalia basiminuta*. Bar line = 10µm.

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MICROSPHAERA BULBOSA NOM. NOV.

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Wang (1987) described Bulbomicrosphaera magnoliae gen. & spec. nov. The new species differs from Microsphaera by the bulbous base of the cleistothecial appendages. Otherwise it agrees fully with Microsphaera. I have revised the type material of this new species (HMAS 50013). The introduction of Bulbomicrosphaera is undoubtedly referred to the generic concept of Uncinula/Bulbouncinula. Recently I have discussed the generic concept of the Erysiphales in detail (Braun 1987). Bulbouncinula is recognized on account of the second type of appendages. The mere existence of the bulbous swellings of the cleistothecial appendages is not sufficient to introduce a new genus. There are some Uncinula as well as Microsphaera species with enlarged, coloured basal cells (e.g. Uncinula bischofiae Wei; Microsphaera magnifica U. Braun, on Magnolia in North America and Japan). B. magnoliae does not possess any other distinguishing characteristics, except the bulbous swellings of the cleistothecial appendages. Therefore, I reduce Bulbomicrosphaera to the synonymy of Microsphaera. Because of M. magnoliae Sawada, it is not possible to transfer B. magnoliae to Microsphaera.

Microsphaera bulbosa U. Braun nom. nov.

Bas.: Bulbomicrosphaera magnoliae A. Q. Wang, Acta Mycol. Sinica 6(2), p.74 (1987).

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JAPANESE SPECIES OF *ASCOSPHAERA*

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SUMMARY

Seven new species of *Ascosphaera* were uncovered by examination of collected bamboo canes with nesting cells and cocoons of the mason bee, *Osmia cornifrons*, from the Nagano region in Japan where more than 30 years extensive use of this species for pollination of apple trees constitutes the basis for accumulation of fungi living in association with the bees. Further, the investigations revealed osmophily or xerophily as the rule rather than the exception in *Ascosphaerales*. Some species required as much as three mol l^{-1} glucose in the media for formation of ripe spore cysts or fairly normal mycelial growth with little collapse.

INTRODUCTION

Already more than 30 years ago, the fruit growers in the Nagano region in Japan had serious problems with pollination of fruit trees because honey bees and wild bees suffered damage from the application of insecticides. This led to an extensive use of hand pollination in order to maintain a constant apple production, and to a search for bees especially suitable for pollination purposes under the prevailing conditions. The best species for use in the apple orchards was found to be the mason bee *Osmia cornifrons* (Radoszkowski) which since has been of increasing importance (Maeta & Kitamura, 1964; Kitamura & Maeta, 1969). The increased populations and number of nesting sites with high amounts of bees gave problems with different kinds of enemies - not least of fungi (Maeta & Kitamura, 1965; Maeta, 1978). The fungi were found on the larval, prepupal, and pupal stages and the percentage seemed to vary from year to year, from one region to another, and from bee species to bee species. The largest amount of fungi on *O. cornifrons*, 24.6% of the nest cells collected, was found in apple orchards at Suzaka City in 1964 (Maeta, 1978). The fungi were not identified.

During the 30th International Apicultural Congress in Nagoya, Japan, in 1985, Dr. Yasuo Maeta kindly invited the author to participate in an excursion to the large apple orchards around Nagano City (cf. Ebato, 1980) in order to see how the fruit growers used *O. cornifrons*.

By use of a simple magnifying glass (x 6) it became immediately clear that the nest cells might contain *Ascosphaera* species new to science. The identification of some of the species are presented below.

Previously *A. apis* (Massen:Claussen) Olive et Spiltoir have been found in Japan (Udagawa & Horie, 1974; Furuya et al., 1981; Furuya, 1982).

MATERIALS AND METHODS

The examined material comprised samples of bamboo canes collected in three apple orchards close to Nagano City. The canes were used as nests for the mason bee, *Osmia cornifrons* (Radoszkowski), and for this aim each cane had an inner diameter of 6 mm and was cut in 15-20 cm pieces. The samples of bamboo canes were taken from bundles placed under the roof of houses or from small huts placed at intervals in the orchards (cf. Kitamura & Maeta, 1969).

When the bamboo canes were split up for examination, it was observed that all three samples were more or less heavily infested with species of mites. They were killed by two three-day exposures to "Vapona" strips (18.6% dichlorovos = o,o-dimethyl o-(2,2-dichlorvinyl) phosphate) after removal of the cocoons with living bees (270 individuals) from sample 3.

The rather small sample 1 was found to be ransacked by mites and larvae of a beetle species, and a direct microscopical examination uncovered only an *Aspergillus* species. This was why this sample was discarded. In the large samples 2 and 3, *Ascosphaera* species occurred almost anywhere in most of the bamboo canes - though to a lesser extent in connection with cocoons with living bees. The provision of a nectar and pollen mixture was in some cases left uneaten, interwoven with mycelium, and mixed with a large number of spore cysts of an *Ascosphaera* species.

Further, Dr. S.N. Holm handed one thousand cocoons of *O. cornifrons* over to the author for examination. In the autumn of 1985 he had received about 5000 cocoons from Dr. E. Takahashi in order to test if this bee would be usable under Danish conditions. After overwintering in the same way as other bees, they were all found dead. The examination unveiled that nearly all of them had died at the fully developed imago stage and with only accidentally occurring fungi that could not provide any reason for the deaths. Only less than one per cent had died at the larval stage after spinning the cocoon, probably already in Japan. These larvae were interwoven by mycelium of an *Ascosphaera* species but without any spore cysts. These were situated on the inner side of the cocoons where they formed a tapestry of closely aggregated spore cysts analogous to that of *A. aggregata* Skou under the larval integument (Skou, 1975), or now and then occurring singly.

Finally, a small sample was received from Dr. Yasuo Maeta who had collected it at Mt. Hoshigami, Shimane Prefecture, Japan, in November 1985.

As far as possible, spore cysts were picked up one by one for examination, macerated and spread on the honey-pollen medium or on MEA with 30% glucose (Skou, 1975; Skou & King, 1984). As soon as growth occurred, the mycelia were transferred to a fresh medium in order to get rid of contaminants and to separate the different *Ascosphaera* species. Per cent glucose denotes w/v glucose monohydrate and MEA with 30% and 60% glucose then equals 1.60 and 3.12 mol l^{-1}, respectively. The fungi were grown in growth chamber at 21°C. Other growth conditions are given under each described species.

Aureomycin was added to all media as a standard in order to avoid bacterial growth.

All comparisons of the species were based on measurements made with an ocular screw micrometer and the results from the ascomata (spore cysts) and their content were based on at least 200 measurings each.

THE SPECIES

1. *Ascosphaera parasitica* Skou sp. nov.

Etymology: The epithet '*parasitica*' is given because the fungus is found growing and sporulating only inside the cocoons of *Osmia cornifrons* (Radoszkowski).

Descriptio: *Ascosphaera parasitica species nova. Mycelium parcum, in superficie larvarum mortuarum. Sporocystae nigrescentes, intus crysalibus dense congestae, ob compressae formis variis vel solitares formis globosis, 143 - 281 - 456 µm magnae, 94 pro 100 inter 200 et 400 µm. Membrana externa hyalina, gelatinosa, palleo brunnea vel flava et membrana interna nigrofusca vel inpellucera, levis, vitro instar fragili constituta. Globuli sporarum sphaerici, 11 - 18.1 - 29 µm magnae, 89.5 pro 100 inter 13 et 23 µm. Ascosporae unicellulares, ellipsoideae vel fusiformes, 1.2 - 1.8 - 2.3 x 4.3 - 6.7 - 8.8 µm magnae, 81 pro 100 inter 1.5 et 2.0 µm latitudine et 94 pro 100 inter 5 et 8 µm longitudine; ratione longitudinis pro latitudinis ita 3.7. Status anamorphosis non observatus.*

Habitat in chrysalibus Osmiae cornifrontis (Radoszkowski) *parasitica.*

Holotypus anno 1986 in chrysalibus Osmiae cornifrontis in regione Nagano, Japonia lectus, in Museo et Herbario Botanico Hauniensi (C) deposito.

Description: Mycelium sparse on the surface of dead larvae. Spore cysts black, tinged with grey in reflected light, either closely aggregated in a tapestry on the inner site of the cocoons and variable in form or singly and globose, 143 - 281 - 456 µm with 94% between 200 and 400 µm. The outer membrane hyaline, gelatinous and pale brown to yellow, the inner membrane dark brown to opaque, smooth, vitreous and brittle. Spore balls globose, 11 - 18.1 - 29 µm with 89.5% between 13 and 23 µm. Ascospores one-celled, elliptical to fusiform, hyaline and colourless, 1.2 - 1.8 - 2.3 x 4.3 - 6.7 - 8.8 µm, 81% with a breadth between 1.5 and 2.0 µm and 94% with a length between 5 and 8 µm. Length-to-width ratio: 3.7 (Fig. 1). Anamorph state not observed.

Habitat in cocoons of *Osmia cornifrons*.

Holotype in cocoons of *Osmia cornifrons* received from E. Takahashi, Nagano, Japan, in 1985. Deposited in the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: About a thousand of the cocoons received from E. Takahashi. The fungus occurred in less than one per cent of this material.

Hitherto no growth on artificial media.

The manner of occurrence suggests that the fungus is parasitic, hence the epithet *parasitica*. Probably the fungus is also pathogenic, but this is not proven.

2. *Ascosphaera verrucosa* Skou sp. nov.

Etymology: '*verrucosa*' = wart-like. The term refers to the sculptured ascospores.

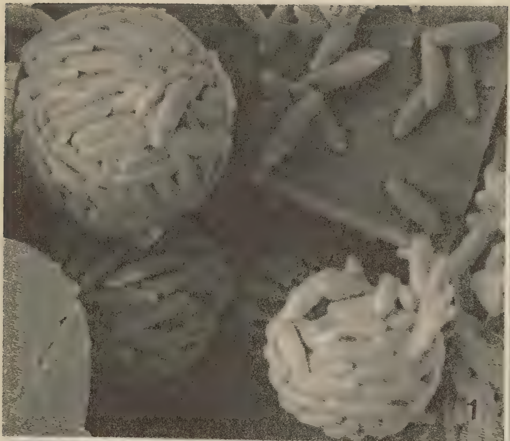
Descriptio: *Ascosphaera verrucosa species nova. Mycelium niveus et sporocystae coracinae intertexta inter mixtura nectaris et pollinis. Sporocystae globosae, 56 - 101 - 140 µm magnae, 92.5 pro 100 inter 70 et 130 µm. Membrana externa hyalina, gelatinosa, nullo colore et membrana interna translucenti spadicea, vitro instar fragili constituta. Globuli sporarum sphaerici, 12 - 16.8 - 24 µm magnae, 82.5 pro 100 inter 14 et 20 µm. Ascosporae unicellulares, verrucosae, ellipsoideae vel subglobosae, superficialis ceracea instar verrucosa, tendentia decidua, 3 - 4.3 - 6 x 4 - 5.8 - 7 µm magnae, 96 pro 100 inter 3.5 et 5.5 µm latitudine et 94 pro 100 inter 5.0 et 6.5 µm longitudine; ratione longitudinis pro latitudinis ita 1.4. Status anamorphosis non observatus.*

Habitat in cibaria Osmiae cornifrontis (Radoszkowski).

Holotypus anno 1985 in cibaria Osmiae cornifrontis (Radoszkowski), *in regione, Nagano, Japonia lectus, in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: The snow-white mycelium and the lustrous ravenblack spore cysts occur interwoven in the provision mixture of nectar and pollen collected by *Osmia cornifrons*. Spore cysts globose, 56 - 101 - 140 µm with 92.5% between 70 and 130 µm. The outer membrane hyaline, gelatinous and colourless. The inner membrane date-brown in translucent light, vitreous and brittle and with variously

Figures 1-5. Spore balls and ascospores of *Ascosphaera* species. 1: *A. parasitica*, 2: *A. verrucosa*, 3 and 4: *A. celerrima*, 5: *A. cinnamomea*. Figure 4: x 12,000 and bar = 1 µm. The others: x 2,000 and bar = 10 µm.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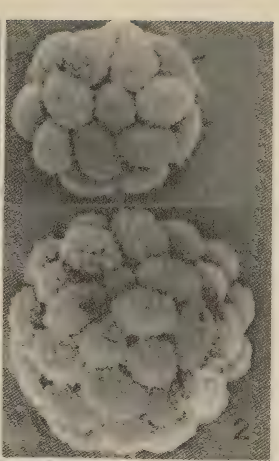
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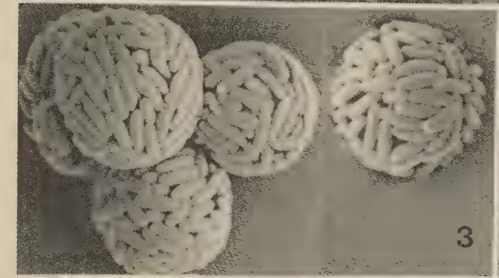
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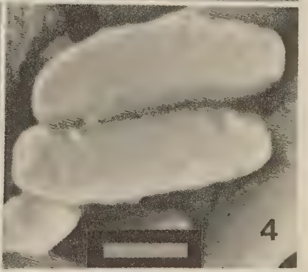
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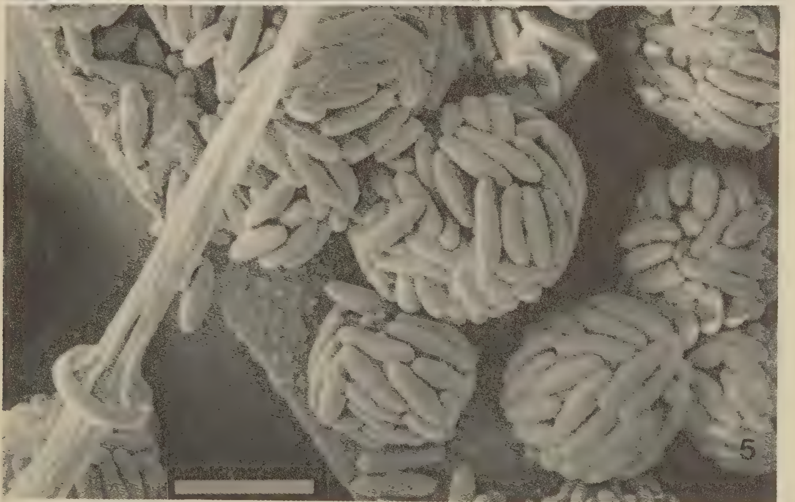
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sized dark spots that tend to be reticulate. Spore balls globose, 12 - 16.8 - 24 µm with 82.5% between 14 and 20 µm. Ascospores one-celled, elliptical to subglobose and verrucose from numerous wax-like, ethanol-soluble grains, 3 - 4.3 - 6 x 4 - 5.8 - 7 µm, 96% with a breadth between 3.5 and 5.5 µm and 94% with a length between 5.0 and 6.5 µm. Length-to-width ratio: 1.4 (Fig. 2). Anamorph state not observed.

Habitat in provisions of *Osmia cornifrons*.

Holotype in provisions of *Osmia cornifrons* collected at Nagano region, Japan, in 1985. Deposited in the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: Two samples collected in the Nagano region and a sample collected by Dr. Y. Maeta at Mt. Hoshigami, Shimane Prefecture, Japan.

Hitherto no growth on artificial media.

3. *Ascosphaera celerrima* Skou sp. nov.

Etymology: '*celerrima*', from '*celer*' = quick, rapid and the superlative suffix '*-rima*'. The term refers to the very fast growth of the fungus.

Descriptio: *Ascosphaera celerrima species nova. Mycelium 5 - 8.2 - 14 µm, album, abundans et celeriter crescens. Sporocystae nigrae, globosae, magnitudine maxime variabili, 45 - 191 - 428 µm magnae, 87 pro 100 inter 75 et 350 µm. Membrana externa hyalina, tenuis, gelatinosa, nullo colore et membrana interna brunnea, levis, vitro instar fragili constituta. Globuli sporarum sphaerici 8 - 12.5 - 18 µm magnae, 86 pro 100 inter 10 et 15 µm. Ascosporae unicellulares, oblongae vel fusiformes, 1.1 - 1.5 - 2.4 x 3 - 4.2 - 6 µm magnae, variatione parva; ratione longitudinis pro latitudinis ita 2.7. Status anamorphosis non observatus.*

Habitat in nidis Osmiae cornifrontis (Radoszkowski) *in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski) *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 390.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium, 5 - 8.2 - 14 µm, white, abundant, and very fast growing at 21°C and ambient room temperature. Spore cysts black, globose, extremely variable in size, 45 - 191 - 428 µm with 87% between 75 and 350 µm. The outer membrane thin, hyaline, gelatinous and colourless. The inner membrane brown, smooth, vitreous and brittle. Spore balls globose, 8 - 12.5 - 18 µm with 86% between 10 and 15 µm. Ascospores one-celled, oblong or fusiforme, 1.1 - 1.5 - 2.4 x 3 - 4.2 - 6 µm with little variation. Length-to-width ratio: 2.7 (Figs 3 and 4). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons*.

Holotype anno 1985 collected in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in the Nagano region, Japan. Culture No. J21 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 390.87. A dried culture of No. J21 is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: From nesting cells in bamboo canes at the nesting site 3 where the large spore cysts were picked up one by one. The fungus was easily purified because of its very fast growth though the presence of *Penicillium* spp. proved destructive to it.

The fungus grows best on MEA with yeast extract and 30% glucose (Skou & King, 1984) or on honey-pollen medium (Skou, 1972).

4. *Ascosphaera cinnamomea* Skou sp. nov.

Etymology: '*cinnamomea*' from '*cinnamomum*' = cinnamon, a bright brown colour. The term refers to the mycelium which changes from white to bright brown during the time of ripening of the spore cysts.

Descriptio: *Ascosphaera cinnamomea species nova. Mycelium 8 - 9.8 - 14 µm crassum, initio album postea ad cinnamomum mutans. Septa intactae in mycelio collapso similia cumuli ossium scelati. Sporocystae brunneae, globosae, 123 - 226 - 350 µm magnae, 82 pro 100 inter 150 et 300 µm. Membrana externa hyalina, gelatinosa, nullo colore et membrana interna brunnea, levis vel maculata dispar, vitro instar fragili constituta. Globuli sporarum sphaerici, 10 - 16.2 - 23 µm magnae, 87.5 pro 100 inter 13 et 20 µm. Ascosporae unicellulares, lanceolatae, apicibus obtusis, 1.7 - 2.1 - 2.5 x 6 - 7.9 - 9 µm, variatione parva; ratione longitudinis pro latitudinis ita 3.8. Status anamorphosis non observatus.*

*Habitat in nidis Osmiae cornifrontis (*Radoszkowski*) in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski) *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 375.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium, 8 - 9.8 - 14 µm diam., initially white but changing to cinnamon during formation and ripening of the spore cysts. At this time it has a pronounced collapsing tendency and develops a cinnamon-coloured liquid cell content, and with the septa left unchanged, indicating why the mycelium gets a bony appearance. Spore cysts brown, globose, 123 - 226 - 350 µm with 82% between 150 and 300 µm. The outer membrane hyaline, gelatinous and colourless (Fig. 12). The inner membrane brown, smooth or with a varying number of dark spots, vitreous and brittle. Spore balls globose, 10 - 16.2 - 23 µm with 87.5% between 13 and 20 µm. Ascospores one-celled, lanceolate with more or less obtuse to fusiforme apices, 1.7 - 2.1 - 2.5 x 6 - 7.9 - 9 µm with little variation. Length-to-width ratio: 3.8 (Fig. 5). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons*.

Holotype collected in 1985 in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in the Nagano region, Japan. Culture No. J61 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 375.87. A dried culture of No. J61 is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: From nesting cells in bamboo canes at nesting site 3 where the cinnamon-coloured mycelium and the brown spore cysts occurred sparsely here and there.

The fungus grows best on MEA with yeast extract and 30% glucose (Skou & King, 1984) or on honey-pollen medium (Skou, 1972).

5. *Ascosphaera fusiformis* Skou sp. nov.

Etymology: '*fusiformis*'; '*fusi-*' from '*fusus*' = spindle and '*-formis*' from '*forma*' = shape. These terms refer to the spindle-shaped ascospores.

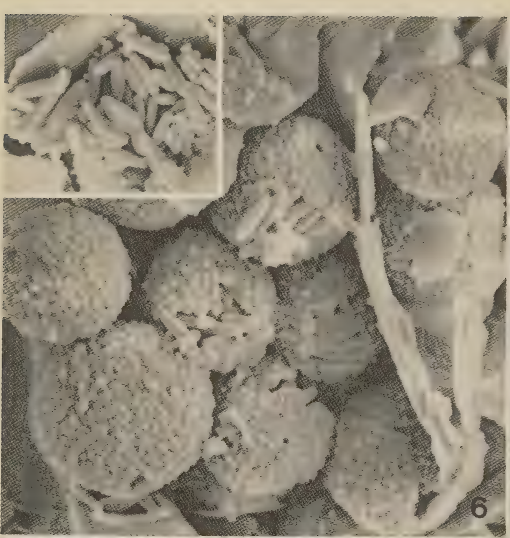
Descriptio: *Ascosphaera fusiformis species nova. Mycelium 2.5 - 3.7 - 5.0 µm crassum, album, dense et humiliter in coloniis non sporiferentibus et mycelium parcum in coloniis sporiferentibus. Diameter coloniae limitatus. Sporocystae nigrae, globosae, 28 - 65 - 132 µm magnae, 89 pro 100 inter 35 et 100 µm. Membrana externa hyalina, gelatinosa, nullo colore et membrana interna translucenti brunnea, levis cum granis numerosis laxis, parvis et fuscis, vitro instar fragili constituta. Globuli sporarum sphaerici, pallides brunnei, 7 - 11.5 - 16 µm magnae, 83 pro 100 inter 9 et 14 µm. Ascosporae unicellulares, fusiformes, 0.6 - 1.0 - 1.6 x 2.9 - 3.9 - 5.1 µm magnae, variatione parva. Ratione longitudinis pro latitudinis ita 4.0. Status anamorphosis non observatus.*

Habitat in nidis Osmiae cornifrontis (Radoszkowski) *in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski) *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 373.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium 2.5 - 3.7 - 5.0 µm in diam., white, dense and low-growing in colonies without spore cysts, whereas the mycelium appears sparse in colonies which are black or almost black due to a huge number of spore cysts. Colony diameter may be rather limited. Spore cysts black,

Figures 6-9. Spore balls and ascospores of *Ascosphaera* species. 6 and 7: *A. fusiformis*, 8: *A. naganensis*, 9: *A. xerophila*. Figure 7: x 12,000 and bar = 1 µm. *The others: x 2,000 and bar = 10 µm.*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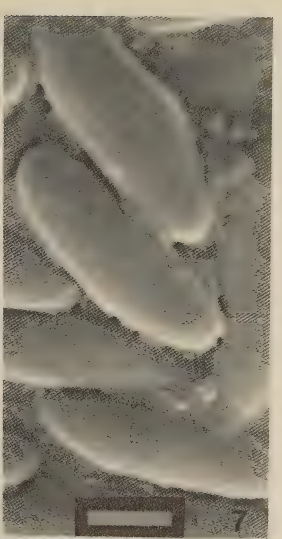
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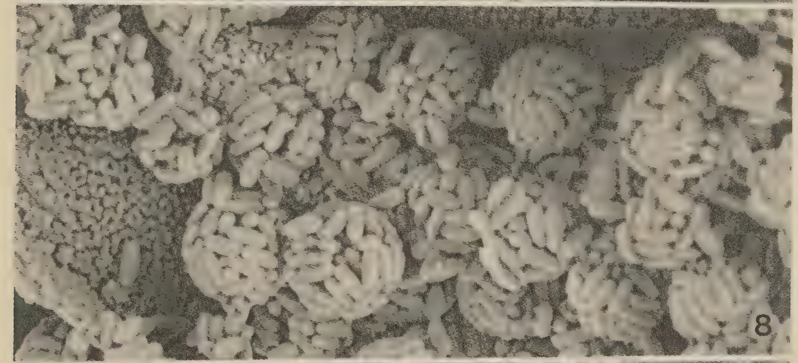
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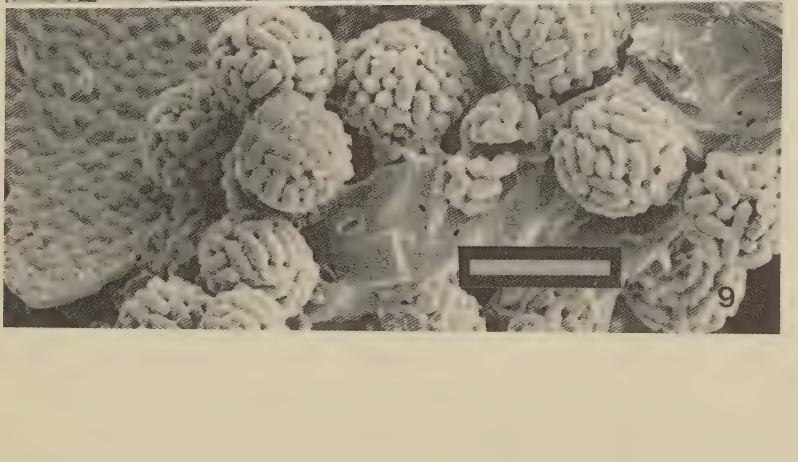
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globose and 28 - 65 - 132 µm in diam. with 98% between 35 and 100 µm. The outer membrane hyaline, gelatinous and colourless. The inner membrane brown in translucent light, smooth with numerous small, loose, dark grains, vitreous and brittle. Spore balls pale brown with an unusually persistent unit membrane (Fig. 6), 7 - 11.5 - 16 µm in diam. with 83% between 9 and 14 µm. Ascospores one-celled, spindle-shaped, and 0.6 - 1.0 - 1.6 x 2.9 - 3.9 - 5.1 µm with little variation. Length-to-width ratio: 4.0 (Figs 6 and 7). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons*.

Holotype anno 1985 collected in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in Nagano region, Japan. Culture No. J1 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 373.87. A dried culture of No. J1 is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: From nesting cells in bamboo canes at nesting site 2 where it occurred in a few cases between other species.

The fungus grows best on MEA with yeast extract (Skou, 1972) and on 30% glucose (Skou & King, 1984) or on the honey-pollen medium.

6. *Ascosphaera naganensis* Skou sp. nov.

Etymology: '*naganensis*' from Nagano. The epithet is given in memory of the visit to Nagano City and the surroundings, and because this species was that most often collected.

Descriptio: *Ascosphaera naganensis species nova. Mycelium album, 5 - 8 - 11 (15) µm crassum cum tendentia conformationis vacuolarum et collapsus, dichotoma ramificatio inconspicua vel dispar. Cellulae nutritoriae et hyphae masculinae abundanter, frequenter formationem sporocystarum incipientes. Sporocystae nigrescentes, 44 - 123 - 330 µm magnae, 93 pro 100 inter 50 et 200 µm, hic interdum vacuae. Membrana externa hyalina, gelatinosa, nullo colore et membrana interna translucenti brunnea, subtiliter maculata, vitro instar fragili constituta. Globuli sporarum sphaerici, 7 - 10.2 - 13 µm magnae, 86 pro 100 inter 8 et 12 µm. Ascosporae unicellulares oblongae, apicibus obtusis, 1.0 - 1.2 - 1.6 x 2.7 - 3.7 - 4.3 µm magnae, variatione parva. Ratione longitudinis pro latitudinis ita 3.0. Status anamorphosis non observatus.*

Habitat in nidis Osmiae cornifrontis (Radoszkowski) *in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski) *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 374.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium white, 5 - 8 - 11 (15) µm in diam. with a tendency to vacuolation and collapse and with less distinct dichotomous ramification than in other species.

Copulative hyphae, '*antheridia*' and '*pronutriocytes*', abundantly present, meet frequently and initiate formation of spore cysts. Spore cysts black with a little tinge of gray, 44 - 123 - 330 µm with 93% between 50 and 200 µm. Now and then many spore cysts are empty which may possibly be due to an early cessation of growth. Empty spore cysts remain transparent. The outer membrane hyaline, gelatinous and colourless. The inner membrane brown in transmitted light, very finely spotted, vitreous and brittle. Spore balls, 7 - 10.2 - 13 µm with 86% between 8 and 12 µm. Ascospores one-celled, oblong with obtuse apices, 1.0 - 1.2 - 1.6 x 2.7 - 3.7 - 4.3 µm with little variation. Length-to-width ratio: 3.0 (Figs 8 and 10). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons.*

Holotype anno 1985 collected in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in Nagano region, Japan. Culture No. J2 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 374.87. A dried culture of No. J2 is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: From nesting cells in bamboo canes at nesting sites 2 and 3 where *A. naganensis* was the most frequently isolated species. It grows fairly well on MEA with yeast extract and 30% glucose but the isolates have a more or less pronounced tendency to vacuolation and collapse of the hyphae and formation of empty spore cysts. Growth is less on the honey-pollen medium (Skou, 1972).

The isolates of *A. naganensis* have all the same general habit and the spore cysts and spore balls are alike, whereas there were found some variation in the length of the ascospores from one isolate to another. Though these differences might be significant, I find it unwise to give them species rank.

7. *Ascosphaera xerophila* Skou sp. nov.

Etymology: '*Xerophila*', from '*xero*' = dry and '*phila*' = loving. The terms refer to the fact that the fungus needs media with very low water activity for formation of fully developed ascomata, the spore cysts.

Descriptio: *Ascosphaera xerophila species nova. Mycelium 2.5 - 3.9 - 6.5 µm crassum, album et gossypinum sub conditione optima, tarde crescens. Sporocystae nigrae, globosae, 44 - 128.6 - 308 µm magnae, 78 pro 100 inter 75 et 200 µm. Membrana externa hyalina, tenuis, gelatinosa, nullo colore et membrana interna nigra, crassa, vitro instar fragili constituta. Globuli sporarum sphaerici 5.5 - 9.7- 13.0 µm magnae, 91 pro 100 inter 8 et 12 µm. Ascosporae unicellulares, ellipticae 1.0 - 1.3 - 1.8 x 2.2 - 2.9 - 3.8 µm magnae, variatione parva; ratione longitudinis pro latitudinis ita 2.2. Status anamorphosis non observatus.*

Habitat in nidis Osmiae cornifrontis (Radoszkowski) *in canna bambusae.*

Holotypus anno 1985 in nido Osmiae cornifrontis (Radoszkowski), *in regione Nagano, Japonia, lectus, in Dania cultus, vivis prolibus in vivario Neerlandico Baarnensi sub numeris CBS 376.87 traditis et mycelio sporifero sicco typifico in Museo et Herbario Botanico Hauniensi (C) deposito.*

Description: Mycelium 2.5 - 3.9 - 6.5 µm, white, cottony and slow growing at the best found growth conditions. Spore cysts black, globose 44 - 128.6 - 308 µm with 78% between 75 and 200 µm. The outer membrane thin, hyaline, gelatinous and colourless. The inner membrane black, unusually thick, vitreous and brittle. Spore balls globose, 5.5 - 9.7 - 13.0 µm with 91% between 8 and 12 µm. Ascospores one-celled, elliptical 1.0 - 1.3 - 1.8 x 2.2 - 2.9 - 3.8 µm with little variation. Length-to-width ratio: 2.2 (Figs 9 and 11). Anamorph state not observed.

Habitat in nests of *Osmia cornifrons*.

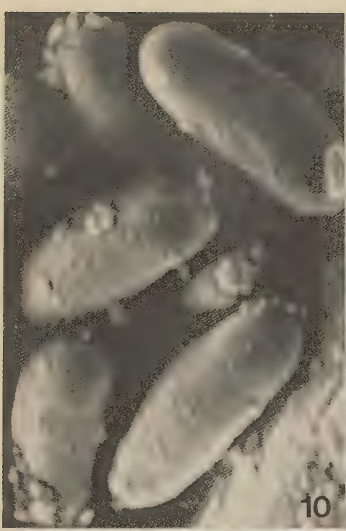
Holotype collected in 1985 in nests of *Osmia cornifrons* (Radoszkowski) in bamboo canes in the Nagano region, Japan. Culture No. J19 deposited at CBS, Baarn, The Netherlands, with accession No. CBS 376.87. A dried culture is chosen as holotype and deposited at the Botanical Museum and Herbarium, Copenhagen, Denmark (C).

Material examined: *A. xerophila* was isolated once only from nesting site 3. It showed a weak mycelial growth on MEA. The growth further increased on MEA with yeast extract and 20% glucose where after some time there came a dark shade on the colony for the reason that many of the young nutriocytes turned brownish, but spore cysts were never seen on this medium. The same picture was seen on honey-pollen medium (Skou, 1972) and on MEA with yeast extract and 30% glucose though with the difference that there came a slow development of spore cysts on the latter medium after some transfers to fresh medium. Addition of 60% glucose gave a fairly good cottony growth with many slowly ripening spore cysts. There was no growth or abnormal growth on several other media tried.

8. Other species

Eremascus albus Eidam, *Aspergillus* spp., mainly *A. repens* (Corda) de Bary and *A. amstelodami* (Mangin) Thom (cf. Holm & Skou, 1972), and *Wallemia sebi* (Fr.) v. Arx (syn. *Sporendonema epizoum* (Corda) Cif. & Red.) often occurred together with species of *Ascosphaeraceae*, *E. albus* especially in connection with the pollen mould *Bettsia alvei*

Figures 10-13. Spore cyst membrane, spore balls and ascospores of *Ascosphaera* species. 10: *A. naganensis*, 11: *A. xerophila*, 12: The gelatinous outer spore cyst membrane of *A. cinnamomea*, 13: *A. apis*. Figures 10 and 11: x 12,000 and bar = 1 µm; 12: x 1,000 and bar = 10 µm; 13: x 2,000 and bar = 10 µm.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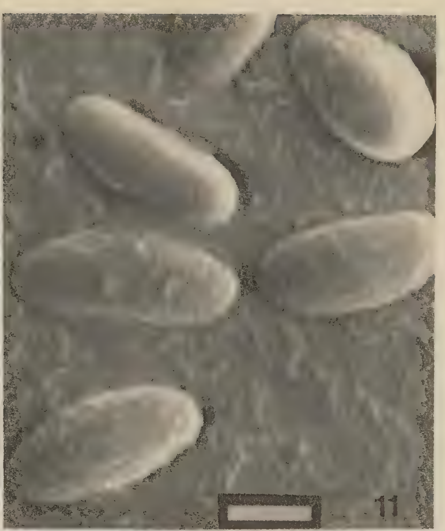
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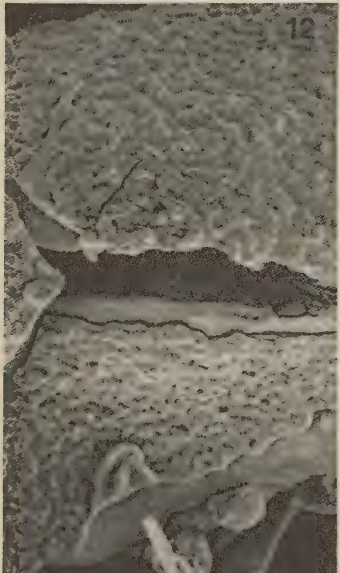
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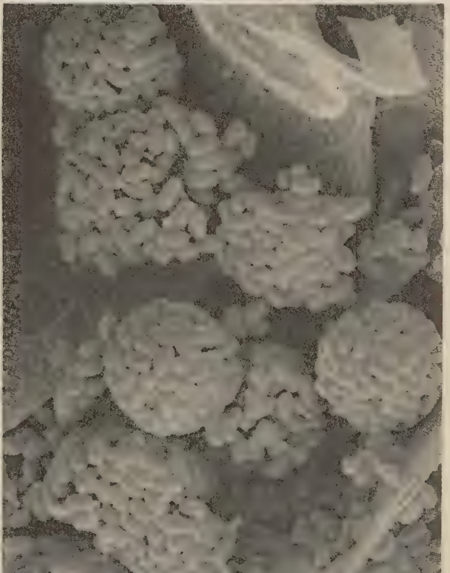
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(Betts) Skou. These fungi were characterized as xerophilic (Pitt & Christian, 1968; Pitt, 1975), including *Chrysosporium fastidium* Pitt (syn. of *C. farinicola* (Burnside) Skou, the anamorph of *B. alvei* (cf. Oorschot, 1980)). Further, the studies of *A. osmophila* Skou & King (1984) drew the attention to osmophily within this group of fungi and led to growth and identification of most of the above-described species.

In several cases the hyphae of isolated mycelia stuck together, vacuolated and collapsed at various early stages of the life cycle. Investigations on the effect of the glucose concentration revealed evidence that these phenomena were connected with the tendency of explosion or lysis of the cells so their content leaked out fast or more slowly. When the glucose concentration was increased the frequencies of these peculiar tendencies were either reduced, delayed or absent, and the growth rate increased.

Addition of 60% glucose not only made it possible to get normal growth of *A. xerophila*; it also initiated formation of spore cysts in some other - in all probability - *Ascosphaera* mycelia difficult to grow. However, these spore cysts later collapsed. Two of these mycelia were grown on this medium (MEA with yeast extract and 60% glucose, cf. Material and Methods) over concentrated $CaCl_2$ and $Mg(NO_3)_2$ solutions in desiccators with air circulation by aquarium pumps giving water activities (a_w) of approximately 0.45 and 0.80, respectively where

$$a_w = \frac{p}{p_o}$$

(p = water pressure over the medium and p_o = water pressure over pure water).

These conditions resulted in good growth of the mycelia in which the hyphae did not stick together. Later the agar medium dried out, obviously with only a slow collapse of the mycelia.

These results established that some *Ascosphaera* species have very extreme requirements which it may be almost impossible to fulfil under artificial conditions.

Finally in this context, several isolations resulted in growth of osmophilic *Chrysosporium* species that have morphological characters and nutritional requirements in common with *C. farinicola* (Pitt, 1966; Skou, 1975, 1986; Oorschot, 1980).

DISCUSSION

It has been said that I mainly base the differences between species on the size of the ascospores (*e.g.* Youssef et al., 1985). This is correct in the sense that they constitute the most constant character, but I find it necessary to base the species on the sum of characters that are "stable enough" to differentiate on species level (*i.e.* the Adansonian principles, cf. Cowan, 1978). Even growth habit and hyphae may be used in this connection. The aerial mycelium shows in all species a repeatedly dichotomous ramification of the hyphae with angles of 45° to

60°. Together with the roughness of the hyphae it normally makes it easy to recognize these species from contaminants, especially *A. osmophila* (Skou & King, 1984), *A. celerrima*, and *A. cinnamomea*. Only in *A. naganensis* is the dichotomous ramification inconspicous which may be connected with the tendency to vacuolate. In *A. osmophila* (Skou & King, 1984) and *A. cinnamomea* (Fig. 5) the septa remain unchanged and stiff when the mycelium collapse. In the latter, this may make the collapsed mycelium looks like a heap of skeletal bones.

The size of spore cysts is the most variable character. An especially large variation was first mentioned on *A. major* (Prökschl & Zobl) Skou (Skou, 1972), later for *A. asterophora* Skou where the size is strongly dependent on the number of spore balls inside that vary from one to about 150 (Skou, 1982), and now for *A. celerrima* where the size of spore cysts varies by a factor of ten.

The presence of the outer spore cyst membrane is usually noted. An impression of its softness and gelatinous character appears from Fig. 12. In most cases this membrane is colourless but in *A. parasitica* it has a hint of yellow or brown. A similar colouring has been seen in an hitherto undescribed, uncultured species. At present I dare not say anything about the stability of this character.

The unit membrane surrounding the young spore balls is evanescent and difficult to observe in most cases, but in *A. fusiformis* it is unusually persistent (Fig. 6). It need not, however, be a good species character as it was formerly observed on an isolate of *A. major* (Skou, 1972).

The size of the spore balls is usually a good character for differentiation between species but Figs 8 and 9 show that it is not always so. A close up of the ascospores, however, shows a clear difference in their shape (Figs 10 and 11). Further, SEM micrographs unveiled a pronounced difference of the internal structure of the vitreous inner membranes of the spore cysts of *A. naganensis* and *A. xerophila* (cf. Skou, 1988). A picture of spore balls and ascospores of the type species *A. apis* is inserted for comparison (Fig. 13).

Ascosphaera verrucosa was found only in nesting cells where the collected provision - mainly pollen - was left uneaten. The yellow pollen mixed with the lustrous raven-black spore cysts was a beautiful sight under the stereo microscope. The reason for the uneaten provision and the absence of egg or larva might be the presence of *A. verrucosa*. Analogous cases are not uncommon in connection with other bees, and neither in those cases were any decisive explanations found (Skou, 1986).

In all cases the ascospores are held together in the spore balls by a substance that hitherto is circumscribed as a mucous substance. The amounts of it are normally so minute that they are visible only in the SEM microscope. It was observed, however, under the examination of *A. verrucosa* that it was grains of such a substance that gave the spores the warty appearence in the light microscope and that the substance is soluble in ethanol. Further, the SEM microscopy disclosed that the substance may lie as a more or less rough, crumbled layer on the inner side of the vitreous inner membrane of the spore cysts (Figs 5, 8 and 13). For these reasons, the substance may be regarded as wax-like rather than mucous or slimy, and it may in reality be such a substance which causes at least some of the structures on the inner membranes mentioned in the descriptions of the various species. Therefore this character must not be given too much taxonomical importance though it obviously differs from one species to another.

When *A. osmophila* was examined years ago we believed that its osmophilic growth requirements were an exception among the *Ascosphaera* species (Skou & King, 1984) but the present investigations of the Japanese species and tests of the other species have shown that osmophily may be the rule rather than the exception. On the other hand, the hyphae of some species may, *e.g. A. xerophila* and mycelia of undescribed species mentioned above, take up so much water that the cells explode even at rather high glucose concentrations in the media. It seems therefore more likely to be a question of reduced water activity in the media (cf. Brown, 1976) and hence of xerophily instead (Pitt & Christian, 1968; Pitt, 1975; Samson et al., 1984; and Skou, unpublished), though humidity might be of importance for the infectivity of *A. apis* and *A. proliperda* Skou (Gilliam, 1986, Youssef et al., 1985).

Very recently Dr. S. Udagawa drew the author's attention to Japanese works (Furuya et al., 1981; Furuya, 1982) that show optimal growth of *A. apis* on 10-20% and of *A. atra, A. major* and *A. proliperda* on 20-30% glucose. This is in close accordance with the author's unpublished observations.

A frequency of varying size of empty spore cysts may occur in any *Ascosphaera* species and in *Bettsia alvei* and probably also in undescribed *Bettsia* species so they grow only in the *Chrysosporium* state (see above; cf. Oorschot, 1980). An explanation cannot be given, but in species as *A. naganensis* and *A. xerophila* it may be a question of fulfilling nutritional or environmental requirements. In *A. xerophila* the development of spore cysts may stop already at the nutriocyte state. The reason for this might be a failure of fertilization due to a too high water activity. It may be mentioned in this connection that the molarity of about three in the medium which gave normal growth of *A. xerophila* is the same which gave optimal growth of *Sporendonema epizoum* (*i.e. Wallemia sebi*) (cf. Ormerod, 1967).

It is known that transfer of *Ascosphaera* species to fresh media easily results in sterile growth because only one of the sexes is carried along. It is especially easy if the transfer is made so early that the very delicate nutriocytes or young spore cysts are disturbed. It is further observed in the case of *A. celerrima* that very fast growth also may increase the possibility of getting sterile growth.

The initial growth of *A. cinnamomea* is white but the whole fungal growth except the ascospores becomes cinnamon coloured towards the ripening of the spore cysts that are darker brown. At that time, the mycelium is rather rough with a pronounced tendency to collapse. It is unknown if the colour and the collapse have anything with each other to do but the mycelium is obviously not dead as it grows out on transfer.

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MORE DETAILS IN SUPPORT OF THE CLASS *ASCOSPHAEROMYCETES*

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SUMMARY

The investigations recognized additional characters to the uniqueness of the ontogenesis and physiology that support Barr's (1983) proposal to give *Ascosphaerales* class rank. The hyphae show pronounced dichotomous branching and have thick-walled, uniperforate, persistent septa. The inner part of the double-layered acellular spore cyst membrane shows unique internal structures that were different on species level. The unit membrane of the spore balls may be considerably persistent. The taxa seem confined to the bee family of *Hymenoptera* and is generally osmophilic or xerophilic.

INTRODUCTION

The *Plectomycetes* class of *Ascomycotina* is so broadly defined that a varying and generally increasing number of orders were included in the course of time though their ontogenesis may be different in several cases (cf. *e.g.* Luttrell, 1951; Malloch, 1979, 1981; Benny & Kimbrough, 1980; Hawksworth et al., 1983).

Hawksworth et al. (1983) reviewed proposed classifications of fungi and gave their own proposal which omit classes within *Ascomycotina* due to difficulties in determining which features should be used in the recognition of higher categories in this very large group of fungi. Consequently the *Plectomycetes* class disappeared.

It may be wise to stop at the level of orders in *Ascomycotina* for a while, but it can hardly remain there. In her presidental address to the Mycological Society of America, Margaret E. Barr (1983) presented a concept of *Ascomycotina* (*Ascomycota*) which might contribute toward bringing the classification of these fungi forward anew. In this concept, Barr (1983) proposed to give *Ascosphaerales* class rank and referred only to the papers of Skou (1972, 1982b). For years, the author has considered if it should stay without further argumentation. In the light of recently observed properties, the author decided to present a series of details that may support Barr's (1983) proposal.

MYCELIA AND ASCOMATA

Hyphae, mycelia and growth habit vary with the species. The hyphae are thin in some species and very thick in others. Those of the aerial mycelia show distinct dichotomous branching (Skou, 1988) with little apical dominance (cf. Robertson, 1965). The dichotomous branching is infrequently inconspicuous when the mycelium has a tendency to vacuolate. The septa are thick-walled, uniperforate and unusually persistent after collapse of the mycelia, especially in *A. osmophila* Skou & King (1984) and *A. cinnamomea* Skou (1988). This phenomenon has also been observed by Kimbrough (1984). The mycelia are generally white, but become bright brown in *A. cinnamomea*. The mycelial habit is either tight and low or cottony in most cases.

The distinct difference between male and female mycelium (of which the latter form nutriocytes that become ascogonia after fertilization, inflate and end up as the spore cysts) have led to the term morphological heterothallism (Olive, 1958). This makes the ascomata ontogenetically fundamentally different from those of cleistothecial fungi, *i.e. Plectomycetes*. For this reason, the diagnosis of *Ascosphaerales* should not be broadened to include fungi with a different ontogeny (Skou, 1982a) as did Benny & Kimbrough (1980) and which has been adopted recently by Eriksson & Hawksworth (1986). The term spore cyst is explained by Skou (1982b). Homothallism has been demonstrated only for *A. atra* Skou & Hackett (1979).

The acellular, membranous spore cyst wall consists of two layers. The outer is gelatinous and usually colourless, and the inner vitreous, fragile and brown to black. SEM microscopy has unveiled new details of the internal structure of the inner membrane. The surface of fractures appears with at least four different shapes. (1) structureless in *A. apis* (Massen:Claussen) Olive & Spiltoir, *A. atra, A. asterophora* Skou (1982a), *A. verrucosa* Skou (1988) (Figs 1, 2, 4, 6, 7), and *A. osmophila* (Skou & King, 1984), (2) fibrous in *A. naganensis* Skou (1988) (Fig. 5), (3) transversly striated in *A. fusiformis* Skou, *A. celerrima* Skou, *A. cinnamomea*, and *A. parasitica* Skou (1988) (Figs 8-11), and (4) structureless double-layered - apparently tenoned together - in *A. xerophila* Skou (1988) (Fig. 12). The thickness of this membrane varies from about 0.3 µm in *A. fusiformis* to about 2.3 µm in *A. xerophila*.

Figures 1, 2, 4, and 5. Fractures of the inner spore cyst membrane of *Ascosphaera* species, 1: *A. apis*, 2: *A. atra*, 4: *A. asterophora*, 5: *A. naganensis*. Figures 2 and 3: Wax-like substance on the inner spore cyst membrane of *A. atra*. x 12,000, bar = 1 µm.

ERRATA, VOLUME THIRTY-ONE

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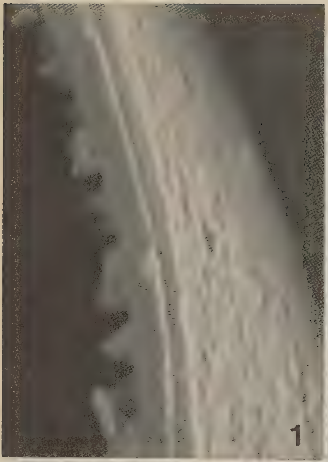
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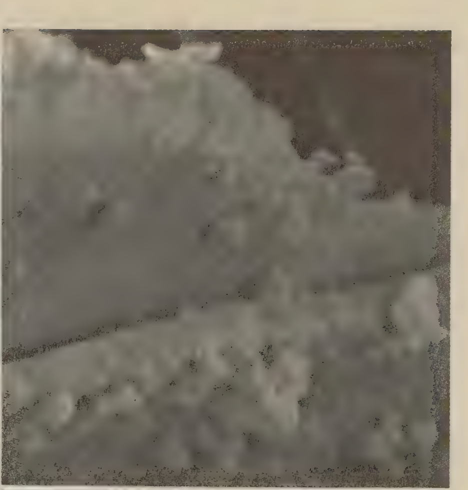

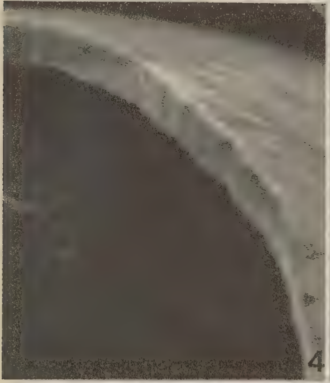
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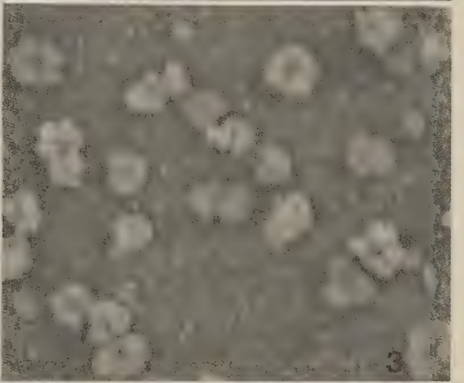
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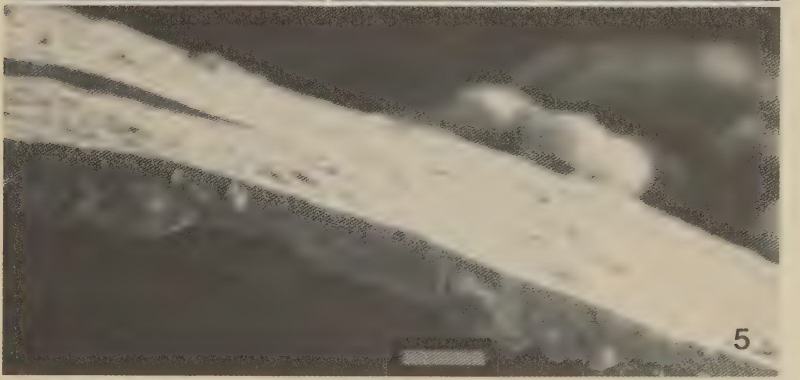
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ASCI VERSUS SPORE BALLS

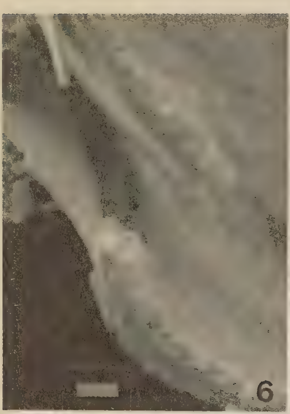
The comprehensive investigations of Varitchak (1933) and Spiltoir (1955) clearly revealed that these fungi belong to *Ascomycotina* but it has since been discussed as to which group of fungi they are related most closely. In this context, much attention has been drawn to evanescence of the asci. It is questionable, however, whether anyone has in reality seen a membrane (tunica) around the ascospores formed after the third nuclear division. Varitchak (1933) found none but said that in spite of this "les oeufs" were separated from the rest of the plasm and that they immediately were transformed to "agglomerations" of spores. Spiltoir (1955) found that the ascus wall either became exceedingly thin or was in the process of disintegration so the outline of the individual asci was soon lost. It may be on this basis that Gäumann (1964) connected *Ascosphaerales* with his subclass of "prototunicaten Ascomyceten" and others connected them with *Plectomycetes*, but in these fungi, the ascospores lie free in the ascomata after deliquescence of the ascus membrane (cf. *e.g.* Luttrell, 1951; Malloch, 1981). Kimbrough (1984) may have seen the membrane as he wrote that intrahyphal cells with compatible nuclei branch, cells disarticulate, and free-floating asci develop within the enlarging ascogonium.

The prototunicate asci of Gäumann (1964) may be regarded to be a fact as did Müller & Loeffler (1982) and Barr (1983) because it is difficult to imagine separation without a membrane but it is quite as difficult to imagine how free-lying, "undressed" ascospores (asci) in a considerable and relatively constant number for each species unite in spore balls within a unit membrane. If the prototunica is to be regarded a primary membrane, then the unit, limiting membrane of the spore balls should be regarded as secondary.

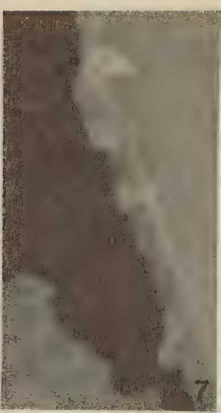
In *Bettsia alvei* (Betts) Skou (1972), the ascospores seem free as in *Plectomycetes* but detailed analyses of the early stages are not made. In *Ascosphaera*, the ascospores occur always in spore balls that are surrounded by an evanescent membrane which in some cases may be considerably persistent, *e.g* in *A. major* (Prökschl & Zobl) Skou (1972) and *A. fusiformis* (Skou, 1988) (Fig. 13). The ascospores in the spore balls of *A. asterophora* (Skou, 1982a) are arranged in one peripheral layer and radiate from an empty centrum. Also in *A. osmophila* (Skou & King, 1984) the spore balls seem hollow.

These characters may raise the question whether the spore balls could be many-spored asci formed by successive divisions from the early 8-spored stage.

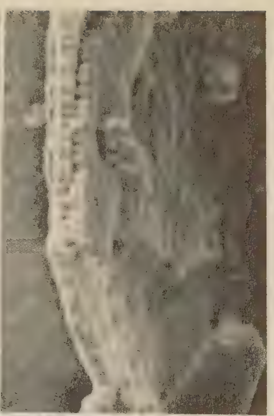
Figures 6-12. Fractures of the inner spore cyst membrane of *Ascosphaera* species. 6 and 7: *A. verrucosa*, 8: *A. fusiformis*, 9: *A. celerrima*, 10: *A. cinnamomea*, 11: *A. parasitica*, 12: *A. xerophila*. Figure 6: x 6,000, bar = 1 µm. Figures 7-12: x 12,000, bar = 1 µm.

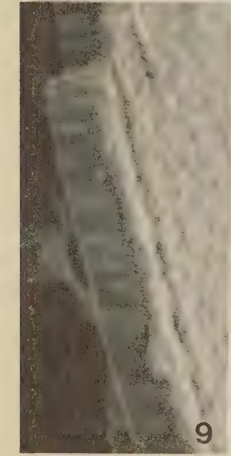


6



7





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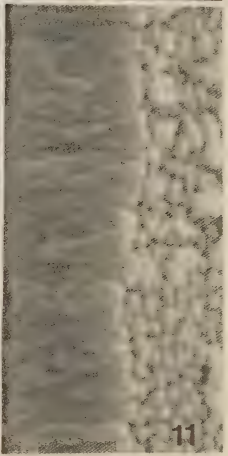

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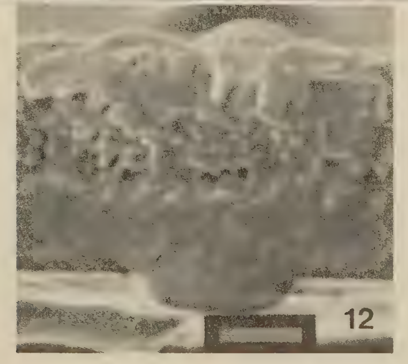

12

The ascospores stick together more or less strongly by a substance which hitherto has been regarded as mucous or slimy, but as it may be soluble in absolute ethanol (Skou, 1988) it is more likely to be of a wax-like or lipidic nature. Besides more or less tightly covering the spores, the SEM microscopy showed that the substance occurs as crumbs both on the spores, *e.g.* on *A. verrucosa* (Skou, 1988), and on the inner side of the spore cyst membrane where it may contribute to the membrane structure when it is examined in translucent light. The size of the crumbs may vary from one species to another and be characteristically structured (Figs 2 and 3). This substance may contribute further to the spreading of these fungi as it may enhance the load of spores sticking to the fur of the bees (Vandenberg et al., 1980).

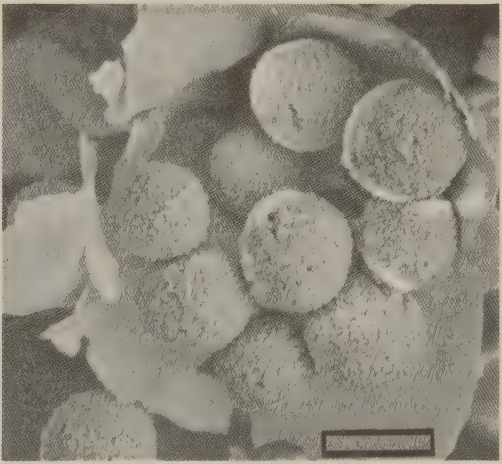

Figure 13. Broken spore cyst of *Ascosphaera fusiformis* with spore balls covered with the unit membrane. x 1,500, bar = 10 µm.

ASSOCIATION AND PHYSIOLOGY

The association of *Ascosphaerales* seems to be strictly confined to the bee family (*Apidae* in *Hymenoptera*). Only *A. atra* and *Chrysosporium farinicola* (Burnside) Skou were observed outside this habitat (Skou, 1986, 1988). Some of the species are pathogenic, especially *A. apis* and *A. proliperda* Skou (1972), that cause chalkbrood in honey bees and different solitary bees, respectively, and *A. aggregata* Skou (1975) which causes ragged brood (also named chalkbrood in U.S.A.) in several species of solitary bees (Skou, 1986). Others - perhaps the main part of the species - are saprophytes that thrive on the nectar and pollen collected by the bees.

Only little work has been done on the physiology of these fungi. It has not yet been possible to grow some of the species on artificial media. Several species may grow on the common fungal media but the fact is that the main part of them prefer up to 30-40% glucose in the medium - in some cases even up to 60% (w/v glucose monohydrate; the concentration of the media then equals 1.60 and 3.12 mol l^{-1} for 30% and 60% glucose, respectively) - and in addition dry air (Skou, 1988 and unpublished). This suggests *Ascosphaerales* to be osmophilic or xerophilic in general. This seems supported by Maghrabi & Kish (1985a, b) who grew the fungi in desiccators.

The protein and isoenzyme patterns were characterized by Maghrabi & Kish (1985a, b, 1986) for several of these fungi. Naturally, they found greater intraspecific similarities than interspecific ones. Most surprising was their finding that the pattern that appears when the mating types were grown together in *A. apis* and *A. asterophora*, respectively, differed clearly from the pattern when the mating types were grown separately.

It is an interesting idea to calculate the relative genetical distance between the species on the basis of such biochemical characters; however, they can hardly be used in the classical taxonomy according to the Code of Botanical Nomenclature. The value of these methods and results lies in their use in connection with for example infection experiments to ensure that the isolate recovered is the same as that used as inoculum.

The author wishes to thank Mr. J. Lindbo and Mr. J.B. Bilde-Sørensen for preparing specimens and for operating the SEM microscope.

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TYPE STUDIES AND NOMENCLATURAL CONSIDERATIONS IN THE GENUS SPARASSIS

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SUMMARY

Type specimens and authentic specimens of eight putative species of Sparassis were examined. Two species are recognized; S. crispa and S. spathulata. Synonymy is proposed.

INTRODUCTION

In a study of the cultural and morphological characters of Sparassis radicata Weir and related species, Martin and Gilbertson (1976) showed that the fungus known as S. radicata in North America was actually conspecific with S. crispa Wulf.: Fr., and what has long been known as S. crispa in eastern North America must be called by a different name. They carried their study no further with respect to species circumscriptions and nomenclatural considerations in the genus *Sparassis*.

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[1] Maintained at Madison, WI, in cooperation with the University of Wisconsin.

More recently, Kreisel (1983) studied *Sparassis* specimens named *S. laminosa*, *S. nemecii*, and *S. brevipes* from Europe and concluded that they represent one species that should be called *S. brevipes*. However, no authentic or type specimens were cited as having been examined.

In this work, we have examined the 8 available type or authentic specimens of the 11 described species of *Sparassis* and *Stereum caroliniense* Cke. et Rav. in an attempt to resolve taxonomic and nomenclatural problems in the genus.

Type or authentic specimens of the following were studied: *S. crispa*, *S. herbstii* Peck, *S. laminosa* Fr., *S. nemecii* Pilát, *S. radicata* Weir, *S. spathulata* Schw.: Fr., *S. tremelloides* Berk., and *S. simplex* D. A. Reid and *Stereum caroliniense*. Neither type nor authentic specimens of *Sparassis brevipes* Krombh., *S. foliacea* St. Amans, and *S. kazachstanicus* Schwarzman were available for study.

MATERIALS AND METHODS

We examined specimens microscopically with a Ziess WL microscope as hand sections and/or as squash mounts in a drop of 2% KOH mixed with a drop of 1% aqueous phloxine, with Melzer's reagent (Ainsworth, 1971) to determine amyloidity or dextrinoidity (if no reaction, indicated as Melzer's -) and with lactophenol aniline blue (Ainsworth, 1971) to detect cyanophily. Herbarium abbreviations are taken from Holmgren and Keuken (1974).

NOTES ON TYPE SPECIMENS

Sparassis brevipes Krombh., Nat. Abbild. Besch. Schw., t. 22, fig. 4. 1834.

The type specimen is not extant according to information from PR.

We believe that the name *S. brevipes* should be considered a *nomen dubium* because only pictures and a description are available to serve as type. Until an appropriate type specimen of *S. brevipes* is found, the Krombholz concept cannot be known with certainty, but having concluded that *S. spathulata* is probably the oldest name for *S. brevipes*, more precise typification of *S. brevipes* is obviated.

Stereum caroliniense Cke. et Rav., J. Mycol. 1:130. 1885.

United States: No. 4104 (Holotype) sent to Ravenel by Dr. Thos. F. Wood of Wilmington, North Carolina, Aug. 1885 (K).

This specimen is conspecific with Sparassis spathulata.

Sparassis crispa Wulf.: Fr., Syst. Mycol. 1:464. 1821.

There is no Wulfen specimen available in UPS. Only one specimen of Fries' at UPS is labeled S. crispa. It was collected by Th. M. Fries in 1869, so it was not available to Fries when he sanctioned S. crispa. We are now attempting to decide on an appropriate specimen to serve as neotype. When those studies are complete, S. crispa will be neotypified.

In the interim, the Fries specimen will represent the present concept of S. crispa. It possesses small, pale to cream-colored and azonate, flabellae extending from the central core of the basidiocarp. Hyphae system monomitic. Tramal hyphae 4-15 µm diam, thin- to somewhat thick-walled, mostly clamped, with scattered broad refractive hyphae up to 15 µm diam; basidiospores broadly ellipsoid, sometimes flattened adaxially, thin-walled, hyaline, 5.5-6 µm diam, with a large central guttule.

Specimens examined: As S. crispa--Sweden: Uppsala, Kungsparken, 1869. Th. M. Fries (UPS). As S. radicata--Holotype, U.S.A.: Idaho; Priest River, Sept. 1916, on roots of Douglas-fir [Pseudotsuga menziesii], Weir 9822; Sept. 29, 1966, on P. menziesii, OKM 4817 (both CFMR) - Oregon; Detroit Nov. 1, 1909, on P. menziesii, FP 1758 (CFMR).

Many authors list basidiospore lengths of 5-7 µm or 6-7 µm. Our study of collections from North America, Europe, and Japan confirms a range of 5-6.5 µm, excluding the apiculus. We were unable to find longer spores. This is important because S. spathulata basidiospores are 6-8 (-9) µm long with a mean of 7 µm. It is possible, therefore, to separate the two species on spore length alone in poorly preserved specimens.

Excellent illustrations of S. crispa basidiocarps are found in Dähncke and Dähncke (1979) and Jahn (1979), and under S. radicata in Martin and Gilbertson (1976) and Miller (1972). However, only Martin and Gilbertson (1976) pictures the radicating base, characteristic of this species. It is not a characteristic feature of S. spathulata.

Sparassis foliacea St. Amans, Fl. Agen., p. 541, t. 11. 1821.

A type specimen for this name cannot be located.

Sparassis herbstii Peck, Bull. Torrey Bot. Club 22:207. 1895.

The type specimen (NYS) agrees well with the neotype specimen of *S. spathulata* (PH).

Specimen examined: U.S.A.: Pennsylvania, Trexlertown, Wm. Herbst, no number or date (Holotype, NYS).

Sparassis kazachstanicus Schwarzman, Flora Spor. rast. Kaz. 4:154. 1964.

The type specimen of *S. kazachstanicus* was not made available for study, and we have not been able to interpret the description to represent one of the two species recognized in this work. Its true identity must await examination of the type. The same situation exists with the genus *Sparassiella* Schwarzman and its type *S. longistipitata* Schwarzman, which appears similar to *Sparassis* spp.

Sparassis laminosa Fr., Antechn. Sverige Atl. Svamp, ed. I, p. 57. 1836.

The specimens cited have both the macro- and micromorphology of *S. spathulata*. To date, we know of no specimen that could be used as neotype. However, the Polish specimen is probably a good representative of the Friesian concept. It is in good condition and was determined by Fries.

Specimens examined: Czechoslovakia: Moravia, ad terram apud *Fagus* et *Abies*, 51870, 13 VIII 59 (PR); ad basim *Abietis*, 611164, 3 VIII 63 (PR); Hradec prope Opava, ad radicis trunci emortui *Abietis albae*, 710448, 5 IX 1969 (PR). All annotated as *S. nemecii* by Pouzar. Poland: Silesia, Kretschmar, no number, no date (UPS).

Sparassis nemecii Pilát et Vesely, Ann. Mycol. 31:56. 1933.

The type and several specimens examined under this name possess the large thick, zonate flabellae typical of *S. spathulata*. Micromorphology is also that of *S. spathulata*. In addition, the junior author observed the species fruiting in Czechoslovakia and noted it to be identical to *S. spathulata* in the United States.

Specimens examined: Czechoslovakia: sub *Fago*, Jánskí Lázné, Montes Corcontici, 1932-X, 168606 (Holotype, PR). See also specimens cited under *S. laminosa*.

Sparassis radicata Weir, Phytopathology 7:166. 1917.

As indicated by Martin and Gilbertson (1976) in their description of the type specimen, it is conspecific with *S. crispa*. Their Arizona isolates of *S. radicata* were genetically compatible with European isolates of *S. crispa*. We agree with Gilbertson (1981) that *S. radicata* is a synonym of *S. crispa*.

Specimens examined: United States: Idaho, Priest River, on roots of Douglas-fir [*Pseudotsuga menziesii* (Mirb.) Franco], Weir 9822 (Holotype, CFMR). See *S. crispa*, also.

Sparassis simplex Reid, Trans. Brit. Mycol. Soc. 41:439. 1958.

This species is based on a poorly developed specimen with only a single flabelliform basidiocarp. The macro- and micromorphology agree with those of *S. spathulata*. The junior author has observed this type of fruiting of *S. spathulata* in the southeastern United States. We consider *S. simplex* to be a synonym of *S. spathulata*.

Specimen examined: England: Box Hill, Surrey, on *Pinus* debris under *Calluna*, P.K.C. Austwick, no number, 2. Oct. 1955 (Holotype, K).

Sparassis spathulata Schw.: Fr., Elench. Fung., p. 227. 1828. ≡ *Merisma spathulatum* Schw., Schr. Nat. Ges. Leipzig 1:110. 1822.

The neotype specimen possesses flabellae up to 2 cm broad, concentrically zonate, varying from pale yellow to light brown, and brittle on drying.

Hyphal system monomitic; context hyphae of two types: 1). (1)4-10(-12) μm diam, hyaline, smooth, simple septate with walls up to 2.5 μm thick; and 2). (2-)6-15(-20) μm diam, thin-walled to firm-walled, smooth, simple septate, with refractive contents staining strongly in phloxine and Melzer's reagent; subhymenium hyphae thin-walled, hyaline, smooth, compact, agglutinated, nodose-septate or simple-septate; hymenium poorly preserved; cystidia not evident; basidia not found; basidiospores ellipsoid to somewhat adaxially flattened, 6-7.5(-9) x 4-5.5 μm, hyaline, thin-walled, smooth, Melzer's -, acyanophilous.

Specimens examined: As *S. spathulata*: United States: Pennsylvania, no location, no date, Schweinitz s.n. (K); Maryland, FP 103936, on *Pinus virginiana* Mill., Laurel (CFMR); North Carolina, Salem, L. v. S [chweinitz] (PH) (neotype, here designated); Salem-Beth[lehem] [PA], 1005-2 Syn. Fung., Epic. 3 (PH); South Carolina, M. A. Curtis, herb. E. Fries (UPS); ad terram, autumno, legit Ravenel, herb. E. Fries (UPS): as *Stereum caroliniense*, holotype (K): as *Sparassis crispa*: Maryland, Laurel, on *Pinus*, JL 240, and under *Quercus*, JL 221; Beltsville, FP 103936 (CFMR); South Carolina, Patrick, on *Pinus*, FP 105840 (CFMR): as *Sparassis herbstii*, holotype (NYS): as *Sparassis laminosa*: Poland, Silesia (UPS); Czechoslovakia, 51870 (PR); 611164 (PR); 710448 (PR): as *Sparassis nemecii* holotype (PR): as *Sparassis simplex* holotype (K).

The specimens cited agree well with the proposed neotype. Miller (1972) illustrated *S. spathulata* as *S. crispa*. Jahn (1979) also illustrated *S. spathulata* (called *S. laminosa*) in Europe. The macroscopic characteristics agree well with *S. spathulata* observed by the junior author in Europe.

Sparassis tremelloides Berk., Grevillea *2*:6. 1873.

The specimen examined possesses longitudinally septate basidia and appears to be an immature specimen of *Tremella reticulata* (Berk.) Farlow. No basidiospores were found. Information on the packet agrees with that in the original description. Therefore, this specimen is being designated neotype.

Specimen examined: South Carolina, M. A. Curtis 1380. Neotype, ex K, isotype in FH.

CONCLUSION

This study revealed two species of *Sparassis* in North America and Europe; *S. crispa* and *S. spathulata*. The organism which has been commonly called *Sparassis crispa* in North America should be called *S. spathulata*. All the other *Sparassis* epithets that we recognize and *Stereum caroliniense* can be placed in synonymy with either *S. crispa* or *S. spathulata*. Our conclusions regarding the synonymy of *S. spathulata* are based entirely on morphological considerations. In Europe, the names *S. nemecii* and *S. laminosa*, ones we believe are synonyms of *S. spathulata*, are deeply rooted and will probably continue to be used. Confrontations of single spore isolates from specimens representing these concepts with those from specimens of *S. spathulata* are needed to support or refute our interpretation of the morphological data.

Until it is thus refuted, we believe the synonymy for *Sparassis* species is as follows:

Sparassis crispa
= *Sparassis radicata*

Sparassis spathulata
= *Stereum caroliniense*
= *Sparassis herbstii*
= *Sparassis laminosa*
= *Sparassis nemecii*
= *Sparassis simplex*

S. brevipes, *S. foliacea*, and *Elvella ramosa* Schaeffer, the earliest name that probably applies to *S. crispa*, can only be interpreted from descriptions. For reasons of priority or devalidation in Fries sanctioning work (1821), none of these names is a competing epithet.

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CODING OF STRAIN FEATURES FOR COMPUTER-AIDED IDENTIFICATION OF YEASTS

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ABSTRACT

The RKC system of coding microbiological data for computers has been extended to include features specifically to aid in coding data for identification of yeasts. By combining the features listed here with those of the more general coding system (7), a set of strain descriptors including inventory and history, can be generated for overall storage and retrieval of yeast strain data.

BACKGROUND AND DISCUSSION

The yeasts are a diverse group of eukaryotic microorganisms. There are about 60 genera and 500 species now recognized (1). To identify a particular strain of yeast to the species level, morphological and growth characteristics are important as are tolerance to inhibitory substances, requirements for certain growth factors, and the ability of the organism to ferment or utilize various carbon and nitrogen sources. These plus other available phenotypic characters can mean that at least 50 observations of phenotypic behavior may be necessary to be certain of the species identity of a given yeast strain.

Morphological and physiological characteristics of currently recognized species of yeast are described in Kreger-van Rij (1). Barnett et al. (2) also provide lists of groups of yeasts and charts of their physiological reactions. The reference works often eliminate the need for searching the open literature to make comparisons of results and observations with an unknown strain. These references (1, 2) provide the basis for the features listed here for use in identifying yeasts. However, manual searching of even these works for matching phenotypes can prove laborious. Computer-aided identification can improve the efficiency and accuracy of identification. The list of characteristics presented herein is designed for such use.

The RKC Coding System has been developed with cooperation from many individuals, government research and regulatory laboratories, international committees and working groups, and special research projects and is maintained by the Microbial Systematics Section, National Institute of Dental Research, National Institutes of Health, Bethesda, MD 20892 USA. Originally, characteristics for bacterial strains only were included (3), but in 1980, protozoan descriptions were added (4). Descriptive items for selected groups of medically important fungi were also added (5). The range of coding possibilities was further broadened to include algal descriptive items in 1983 using a 1977 publication (6). The expanded and revised RKC Coding System has been recently published in book form under the auspices of the Committee on Data for Science and Technology (CODATA) (7).

Since many bacterial and yeast characteristics overlap, many of the original features from the bacteria were used for this yeast coding set. However, because of the unique applications to yeast biology, several new features had to be added and assigned new numbers.

In the RKC coding system, the descriptors are grouped in sections such as Individual Cell Morphology (section 3), Individual Vegetative Cell Size (section 4), Branching, Hyphae and Production of Asexual and Sexual Spores (section 8), Mode of Cell Division (section 14), Vegetative Cell Temperature (section 17), Metabolic Reactions (section 24), and Carbohydrate Metabolism (section 25). Some of the features listed in one group may be cross-listed under another heading. For example, the statement "The organism is heterothallic." is in section 8 under Production of Sexual Spores and in section 14 under Mode of Cell Division (albeit with the same code number).

A characteristic can be judged positive (1), negative (0), or no information (blank). If the organism has, for example, pleomorphic cells and some of the cells are oval and others are apiculate then all three descriptors: 003023-pleomorphic cells are characteristic, 003146-cells are ovate (egg-shaped), and 003028-cells are apiculate, are scored as positive. If a descriptor is not found in the Code list, then one can be added by assigning it a temporary number between 98,000 and 99,999.

With reference to the yeasts, there are several descriptive terms that, mycologically, all mean the same thing. In particular, the terms spore and conidia both refer to a propagative unit produced by a fungus. In this set of descriptors, the term conidia is used to describe how or where it is produced. Blastospores, arthrospores, and ascospores are produced blastically, arthrically, and in an ascus, respectively.

A computer managed set of data coded by use of descriptors such as those described in this communication could enable the investigator to enter the data on the new strain and use the computer to aid in the identification process by use of keys, matrices, or probability calculations. Even when computer analysis does not give a definitive identification, the results reduce the number of species that have to be considered and will optionally suggest additional tests that can be performed to improve the identification. If more than one organism is suggested, research into specific literature on those particular ones can be done. This has proven to be less time consuming and more accurate than doing the whole process manually.

Information on various yeast strains, like the bacteria, can be numerous and matching an unknown yeast to a known one may prove to be difficult and time consuming. There are many morphological and physiological observations to be compared. Like most other technologies, this information can be computerized, alleviating time and accuracy problems. Using the RKC Coding System developed initially for bacteria, data on yeasts have been added for storage, retrieval, and analysis.

INDIVIDUAL CELL MORPHOLOGY

003001: Cells are spherical (all perpendicular axes have ratios between 6:5 and 1:1).
003004: Cells are elliptic (ellipsoidal).
003007: Cells are triangular.
003027: Cells are ogival.
003028: Cells are apiculate.
003156: Cells are lunate (arcuate, bow-shaped, crescent-shaped).
003146: Cells are ovate (egg-shaped).
003180: Cells are oblong.
003008: Cells are rod-shaped (cylindrical).
003183: Cells are cylindrical giant cells.
003005: Cells are pyriform (pear-shaped).
003181: Cells are tetrahedral.
003182: Cells are rhombohedral.
003023: Pleomorphic cells are characteristic.

INDIVIDUAL VEGETATIVE CELL SIZE

004003: Longest axis of each cell is 1.1 - 2.0 µm.
004004: Longest axis of each cell is 2.1 - 3.0 µm.
004005: Longest axis of each cell is 3.1 - 4.0 µm.
004006: Longest axis of each cell is 4.1 - 5.0 µm.
004007: Longest axis of each cell is 5.1 - 10 µm.
004008: Longest axis of each cell is 11 - 15 µm.
004009: Longest axis of each cell is 16 - 100 µm.
004013: Shortest axis of each cell is 1.1 - 2.0 µm.
004014: Shortest axis of each cell is 2.1 - 3.0 µm.
004015: Shortest axis of each cell is 3.1 - 4.0 µm.

004016: Shortest axis of each cell is 4.1 - 5.0 µm.
004017: Shortest axis of each cell is 5.1 - 10 µm.
004018: Shortest axis of each cell is 11 - 15 µm.
004019: Shortest axis of each cell is 16 - 100 µm.

INTRACELLULAR AND EXTRACELLULAR DEPOSITIONS

005009: Cell contains lipid globules.
005024: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 6.
005025: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 7.
005026: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 8.
005027: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 9.
005028: The number of isoprene units in the side chain of coenzyme Q (ubiquinone) is 10.

MISCELLANEOUS SPORES, CONIDIA, AND HYPHAE

008662: True mycelium is produced.
008663: Pseudomycelium is produced.
008342: Hyphae are septate.
008344: Hyphae are nodose-septate (clamp connections present).
008345: Clamp connections are single.
008346: Clamp connections are multiple.
008667: Septa have plasmodesmata.
008668: Septa have single micropores.
008669: Septate hyphae have dolipores.
008670: Dolipore has a primitive cap.
008671: Dolipore has a vesicular cap.
008672: Dolipore has a tapped edge.
008673: Dolipore has a well developed cap.
008753: Dolipore is plugged.
008674: Hyphae are dikaryotic.
008675: Hyphae are monokaryotic.
006001: Endospores are produced (any refractile intracellular body capable of germination into a new vegetative cell).
008020: Fragmentation results in exogenous arthrospores.
008030: Conidia are produced.
008521: Conidia are cylindrical (sausage-shaped).
008522: Conidia are clavate.
008523: Conidia are oval.
008676: Conidia are needle-shaped.
008442: Conidiophores are produced.
008677: Conidia are formed on conidiophores in sympodulae.
008678: Conidia are terminal.
008383: Conidial surface is smooth.
008363: Chlamydospores are present.
008398: Ballistospores are produced.
008679: Ballistospores are asymmetrical.
008456: Blastospores are produced.
008680: Blastospores have long filamentous appendages.

008681: Blastese-like structures are formed.
008617: Sexual reproduction occurs.
008618: Organism is homothallic (male and female on same mycelium).
008619: Organism is heterothallic (male and female on separate mycelia exhibit interfertility).
008634: Asci are produced.
008682: Ascus is the mother cell.
008683: Asci are formed by mother-daughter cell conjugation.
008684: Asci are formed by conjugation of two cells.
008685: Asci are formed by conjugation of two hyphae.
008686: Asci are formed directly by diploid cells.
008687: Asci are formed exclusively on the hyphae.
008688: Asci develop from swollen hyphal cells.
008689: Asci are formed on diploid hyphae.
008690: Asci are sac-like protrusions transformed from vegetative cells.
008691: Asci have small vegetative apical cells attached.
008692: Asci have abortive conjugation tubes.
008693: Asci occur on ascophores.
008694: Asci occur in chains.
008695: Asci occur in brush-like arrangements.
008755: Asci are in groups at ends of hyphae.
008756: Asci are in groups at septa.
008636: Asci are round (spherical, globose).
008754: Asci are oval.
008696: Asci are banana-shaped.
008697: Asci are elongated.
008698: Asci are cylindrical.
008699: Asci are spindle-shaped.
008700: Asci are clavate.
008701: Asci are sphaeropedunculate.
008702: Asci are ellipsoidopedunulate.
008703: Asci are dehiscent (evanescent).
008704: Asci are persistent.
008705: Ascospores are produced.
008706: One ascospore is produced.
008707: Two ascospores are produced.
008708: Three ascospores are produced.
008640: Four ascospores are produced.
008709: Five ascospores are produced.
008710: Six ascospores are produced.
008711: Seven ascospores are produced.
008641: Eight ascospores are produced.
008712: More than eight ascospores are produced.
008638: Ascospores are oval.
008639: Ascospores are round.
008713: Ascospores are fusiform.
008714: Ascospores are helical.
008715: Ascospores are hat-shaped.
008716: Ascospores are spherical with tangential rims (saturn-shaped).
008717: Ascospores are hemispherical.
008718: Ascospores are crescentiform.
008719: Ascospores are reniform.

008720: Ascospores are oblong with obtuse ends.
008721: Ascospores are prolate spherical.
008722: Ascospores are prolate ellipsoidal.
008723: Ascospores are needle-shaped.
008724: Ascospores are attenuated at both ends.
008725: Ascospores are clavate.
008726: Ascospores have smooth walls.
008727: Ascospores have warty walls.
008728: Ascospores have spiny surfaces.
008729: Ascospores are rugose.
008730: Ascospores are hyaline.
008731: Ascospores are brown.
008732: Ascospore is thickened at both poles and gives the appearance of appendages.
008733: Ascospores have whip-like appendages.
008734: Ascospores have ridges that run over the poles.
008735: Ascospores contain lipid or oil globules.
008736: Ascospores are liberated (at maturity or otherwise).
008737: Ascospores tend to agglutinate when liberated.
008738: Basidia are formed.
008739: Basidia are formed in synnemata.
008740: Basidia are formed on loose hyphae.
008741: Basidiocarps (fruiting bodies) are formed.
007073: Basidiospores are present.
008742: Basidiospores are produced in chains.
008743: Basidiospores are smooth.
008744: Basidiospores are rough.
008656: Probasidium is formed.
008657: Probasidium is septate.
008658: Sporidia are formed.
008659: Sporidia are lateral.
008660: Sporidia are terminal.
008655: Teliospores are formed.
008745: Teliospores are highly angular.
008746: Teliospores are spherical.
008747: Teliospores are cleft.
008748: Teliospores are dioboate.
008749: Teliospores are diclavate.
008750: Teliospores do not germinate.
008751: Germ tubes are formed.
011001: Capsule is present.

MODE OF CELL DIVISION

014003: Cells reproduce by budding directly from mother cell.
014004: Daughter cells bud on tubular outgrowths from mother cells.
014012: One or more daughter cells can form at one pole or both poles of the cell.
014018: Conjugation occurs.
014037: Cell has mating type.
014050: Cells undergo fission.
014051: Multilateral budding is present.

014052: Organism has a unifactorial incompatibility mating system.
014053: Organism has a bifactorial mating system.
014054: Organism has a biallelic mating control system.
014055: Organism has a multiple mating control system.

ARRANGEMENT

015001: Cells occur singly.
015002: Cells occur in pairs.
015004: Cells occur in chains.
015005: Cells are arranged in irregular aggregates.
015007: Cells are arranged in cubical packets (three-dimensional).

COLONY CHARACTERISTICS ON SOLID MEDIA

016008: Agar macrocolony margin is entire.
016009: Agar macrocolony margin is erose.
016010: Agar macrocolony margin is filamentous (rhizoid).
016011: Agar macrocolony margin is irregular.
016362: Agar macrocolony margin is undulate.
016361: Agar macrocolony margin is lobate.
016189: Agar macrocolony is convex.
016017: Agar macrocolony is raised but not convex.
016022: Colony consistency is butyrous (soft, buttery).
016023: Colony consistency is viscid (mucoid).
016027: Colony surface is glistening.
016028: Colony surface is dull (matte).
016029: Colony surface is powdery, dry.
016030: Colony surface is smooth.
016031: Colony surface is rough.
016491: Colony surface is wrinkled.

PIGMENTS AND ODORS

020001: Colonies are pure (paper) white on solid medium.
020002: Colonies are gray on solid medium.
020108: Colonies are cream colored.
020008: Pigments are produced only in the light (photochromogenicity).
020038: Nondiffusible red pigments are produced.
020043: Nondiffusible golden (yellow) pigments are produced.
020021: Diffusible yellow pigments are produced.
020045: Cells contain carotenoid pigments.
020107: Pulcherrimin (noncarotenoid, Bordeaux-red pigment) is produced.
020062: Detectable odor is present.
020063: Detected odor is fragrant (e.g., fruity, wintergreen).
020064: Detected odor is musty.
020079: Detected odor is putrefactive.
020106: Detected odor is alcoholic (e.g., ethanol).

GROWTH CHARACTERISTICS IN LIQUID MEDIA

016041: Cells form an easily dispersible sediment in liquid culture.
016043: Floccular growth occurs in liquid culture.
016044: Ring growth on the wall of the tube occurs in liquid culture.
016045: Culture grows on walls of container without clouding the medium.

pH LIMITS OF GROWTH

016057: Growth takes place at an initial pH of 4.0.
016172: Growth takes place at an initial pH of 4.5.
016375: Growth takes place at an initial pH of 4.8.
016056: Growth takes place at an initial pH of 5.0.
016193: Growth takes place at an initial pH of 5.5.
016288: Growth takes place at an initial pH of 5.7.
016055: Growth takes place at an initial pH of 6.0.
016376: Growth takes place at an initial pH of 6.5.
016054: Growth takes place at an initial pH of 7.0.
016377: Growth takes place at an initial pH of 7.5.
016352: Growth takes place at an initial pH of 8.5.
016053: Growth takes place at an initial pH of 9.0.
016165: Growth takes place at an initial pH of 9.6.

VEGETATIVE CELL TEMPERATURE RELATIONSHIPS

017012: Growth occurs at 10 C.
017013: Growth occurs at 15 C.
017037: Growth occurs at 20 C.
017070: Growth occurs at 24 C.
017014: Growth occurs at 25 C.
017071: Growth occurs at 26 C.
017033: Growth occurs at 30 C.
017015: Growth occurs at 37 C.
017017: Growth occurs at 45 C.

CULTURAL CONDITIONS, INHIBITORS, NUTRITION, GROWTH, LIFE CYCLES

016059: Growth occurs from loop inoculum spread on surface of solid media incubated in air.
016485: Added gaseous carbon dioxide is required for growth.
016489: Growth occurs in media overlaid with corn or olive oil.
016212: At least one vitamin (growth factor) is required for growth.
029057: P-Aminobenzoic acid is required for growth.
016107: Biotin is required for growth.
016108: Folic acid is required for growth.
016110: Niacin (nicotinic acid) is required for growth.
016111: Pantothenic acid is required for growth.
016112: Pyridoxal or pyridoxamine is required for growth.

016114: Thiamine is required for growth.
016484: Meso-inositol is required for growth.
018028: Added NaCl is required for growth.
018026: Growth occurs in the presence of 0.1% NaCl (1 ppt).
018003: Growth occurs in the presence of 0.5% NaCl (5 ppt).
018024: Growth occurs in the presence of 1% NaCl (10 ppt).
018025: Growth occurs in the presence of 1.5% NaCl (15 ppt).
018019: Growth occurs in the presence of 2% NaCl (20 ppt).
018004: Growth occurs in the presence of 3% NaCl (30 ppt).
018005: Growth occurs in the presence of 4% NaCl (40 ppt).
018006: Growth occurs in the presence of 5% NaCl (50 ppt).
018021: Growth occurs in the presence of 6% NaCl (60 ppt).
018020: Growth occurs in the presence of 6.5% NaCl (65 ppt).
018007: Growth occurs in the presence of 7% NaCl (70 ppt).
018022: Growth occurs in the presence of 7.5% NaCl (75 ppt).
018023: Growth occurs in the presence of 8% NaCl (80 ppt).
018008: Growth occurs in the presence of 10% NaCl (100 ppt).
018009: Growth occurs in the presence of 15% NaCl (150 ppt).
018010: Growth occurs in the presence of 20% NaCl (200 ppt).
018011: Growth occurs in the presence of 25% NaCl (250 ppt).
018027: Growth occurs in the presence of 32% NaCl (320 ppt).
018032: Growth occurs in the presence of 50% glucose.
018034: Growth occurs in the presence of 60% glucose.
016486: Organism grows in media containing 1% acetic acid.
016487: Growth occurs on canavanine glycine bromthymol blue (CGB) agar.
016488: Canavanine glycine bromthymol blue agar (CGB) turns blue in 2 to 5 d.
016137: Ammonium salts can serve as the sole source of nitrogen for growth.
016138: Nitrate can serve as the sole source of nitrogen for growth.
016139: Nitrite can serve as the sole source of nitrogen for growth.
030141: Cadaverine can be used as the sole source of nitrogen.
030508: Imidazole (1,3-diaza-2,4-cyclopentadiene) can be used as the sole source of nitrogen.
033006: Strains may be successfully lyophilized.

METABOLIC REACTIONS

024009: Gelatin is hydrolyzed (liquefied).
025367: Arbutin is hydrolyzed.
034143: Urease (3.5.1.5) is produced.
024016: Acetic acid is produced from D-glucose.
024190: Tetrazolium dyes are reduced.
024252: Extracellular starch-like materials are produced.

024353: Acetic acid is produced from complex basal medium.
024463: Diazonium Blue B (DBB) dye turns red when applied directly to agar or broth medium.

CARBOHYDRATE METABOLISM - ACID PRODUCTION

025194: Acid is produced from D-galactose.
025195: Acid is produced from D-glucose.
025207: Acid is produced from α-methyl-D-glucoside.
025211: Acid is produced from cellobiose.
025212: Acid is produced from lactose.
025213: Acid is produced from maltose.
025214: Acid is produced from melibiose.
025215: Acid is produced from sucrose.
025216: Acid is produced from trehalose.
025217: Acid is produced from D-melezitose.
025218: Acid is produced from raffinose.
025225: Acid is produced from inulin.
025226: Acid is produced from starch.

CARBOHYDRATE METABOLISM - GAS PRODUCTION

025252: Gas is produced from D-galactose.
025253: Gas is produced from D-glucose.
025265: Gas is produced from α-methyl-D-glucoside.
025269: Gas is produced from cellobiose.
025270: Gas is produced from lactose.
025271: Gas is produced from maltose.
025272: Gas is produced from melibiose.
025273: Gas is produced from sucrose.
025274: Gas is produced from trehalose.
025275: Gas is produced from D-melezitose.
025276: Gas is produced from raffinose.
025283: Gas is produced from inulin.
025284: Gas is produced from starch.

CARBOHYDRATES AS SOLE SOURCE OF CARBON

025296: D-Arabinose can be used as the sole source of carbon.
025297: L-Arabinose can be used as the sole source of carbon.
025300: D-Ribose can be used as the sole source of carbon.
025302: D-Xylose can be used as the sole source of carbon.
025307: L-Rhamnose can be used as the sole source of carbon.
025310: D-Galactose can be used as the sole source of carbon.
025311: D-Glucose can be used as the sole source of carbon.
025313: L-Sorbose can be used as the sole source of carbon.
025323: α-methyl-D-glucoside can be used as the sole source of carbon.
025326: Salicin can be used as the sole source of carbon.
025327: Cellobiose can be used as the sole source of carbon.
025328: Lactose can be used as the sole source of carbon.

025329: Maltose can be used as the sole source of carbon.
025330: Melibiose can be used as the sole source of carbon.
025331: Sucrose can be used as the sole source of carbon.
025332: Trehalose can be used as the sole source of carbon.
025333: D-Melezitose can be used as the sole source of carbon.
025334: Raffinose can be used as the sole source of carbon.
025341: Inulin can be used as the sole source of carbon.
025342: Starch can be used as the sole source of carbon.

ALCOHOLS AS SOLE SOURCE OF CARBON

026515: Ethanol can be used as the sole source of carbon.
026518: Methanol can be used as the sole source of carbon.
026555: 1,2,3-Propanetriol (glycerol) can be used as the sole source of carbon.
026556: Erythritol can be used as the sole source of carbon.
026559: Adonitol can be used as the sole source of carbon.
026563: L-Arabitol can be used as the sole source of carbon.
026565: Meso-xylitol can be used as the sole source of carbon.
026567: Dulcitol can be used as the sole source of carbon.
026575: D-Mannitol can be used as the sole source of carbon.
026578: D-Sorbitol can be used as the sole source of carbon.
026589: Meso-inositol can be used as the sole source of carbon.

ACIDS AND AMINO ACIDS AS SOLE SOURCE OF CARBON

028134: Succinic acid can be used as the sole source of carbon.
028164: DL-Lactic acid can be used as the sole source of carbon.
028173: Citric acid can be used as the sole source of carbon.
028175: 2-Ketogluconic acid can be used as the sole source of carbon.
028208: D-Gluconic acid can be used as the sole source of carbon.
028209: Glucuronic acid can be used as the sole source of carbon.
028699: 5-Ketogluconic acid can be used as the sole source of carbon.
029115: L-Arginine can be used as the sole source of carbon.
029126: Glycine can be used as the sole source of carbon.
029143: L-Proline can be used as the sole source of carbon.
029153: L-Valine can be used as the sole source of carbon.
030102: Glucosamine can be used as the sole source of carbon.

AMINO ACIDS AND AMINES AS SOLE SOURCE OF NITROGEN

029188: L-Lysine can be used as the sole source of nitrogen.
029172: Creatine can be used as the sole source of nitrogen.
029641: Creatinine can be used as the sole source of nitrogen.
030142: Ethylamine can be used as the sole source of nitrogen.

NUCLEUS

037090: Cells are diploid (2N or twice the basic (haploid) number set of chromosomes).
037091: Cells are haploid (N or single basic set of chromosomes).
037104: Cells are triploid.
037105: Cells are tetraploid.
037106: Cells are hexaploid.
037107: Cells are polyploid.

CYCLOHEXIMIDE (ACTIDIONE) SUSCEPTIBILITY

040389: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 0.01 µg/ml.
040390: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 0.01 µg/ml.
040391: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 0.05 µg/ml.
040392: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 0.05 µg/ml.
040393: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 0.1 µg/ml.
040394: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 0.1 µg/ml.
040395: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 1 µg/ml.
040396: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 1 µg/ml.
040399: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 25 µg/ml.
040400: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 25 µg/ml.
040401: Organism is susceptible to cycloheximide (Actidione) concentration in medium of 100 µg/ml.
040402: Organism exhibits intermediate resistance to cycloheximide (Actidione) concentration in medium of 100 µg/ml.

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PHYTOCONIS, THE CORRECT GENERIC NAME FOR THE BASIDIOLICHEN BOTRYDINA

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ABSTRACT

Application of recent changes in the International Code of Botanical Nomenclature necessitates the substitution of the generic name *Phytoconis* for *Botrydina*, and of the specific epithet *ericetorum* for *botryoides*.

INTRODUCTION

The systematics of a small group of lichenized basidiomycetes formerly placed in *Omphalina* was discussed at length by us (Redhead & Kuyper 1987). Guided by strict interpretation of the 1983 edition of the International Code of Botanical Nomenclature (ICBN) adopted at Sidney, a large number of difficult nomenclatural problems were resolved. Subsequent to the publication of our article, new changes which affect these names were made to the ICBN at the XIV International Botanical Congress, June 1987, in Berlin. At this congress, article 63.1 (ICBN) was modified to state unequivocally that lectotypification is not retroactive (Art. 63 proposal B, Greuter and McNeill, 1987). One result is the generic name *Phytoconis* Bory de St. Vincent (1797) is not automatically typified by the later designated lectotype of *Byssus* L. as we suggested. We must now accept the lectotypification of *Phytoconis* with *Byssus botryoides* L. by Drouet and Daily (1956). It follows that *Botrydina* Brébisson (1839), also typified by *B. botryoides* is superfluous. The generic name *Botrydina* has been linked to literature on lichenized agarics for over 20 years. However its adoption for a distinct genus of agarics is new. Hence, rather than conserve *Botrydina* we propose adoption of the name *Phytoconis*.

A second change to ICBN (Art. 13 proposals B & C) approved in Berlin has conferred 'sanctioned status' to a few names treated in the Systema Mycologicum previously excluded from the 'sanctioned' list because they were based upon lichenized fungi. The commonest lichenized agaric, which we treated as *Botrydina botryoides*, was described by Fries (1821) under the name *Agaricus ericetorum* Pers. Persoon's (1796) name, *A. ericetorum*, was a nomen novum for *A. pseudoandrosaceus* Bull. as indicated by us (Redhead and Kuyper, 1987). In addition, we showed that *A. pseudoandrosaceus* and *Byssus botryoides* are conspecific. The correct name for this species now should be based on the sanctioned binomial, *A. ericetorum*, rather than on the earlier name *Byssus botryoides*.

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* Publ. No. 344 of the Biological Station at Wijster

RESULTS

The following new combinations are proposed as substitutes for those in *Botrydina* used by us in 1987:

Phytoconis aurantiaca (Redhead & Kuyper) comb. nov.
=*Botrydina aurantiaca* Redhead & Kuyper, Arctic and Alpine Mycology II, p. 334. 1987. Plenum Press, N.Y.

Phytoconis chromacea (Cleland) comb. nov.
=*Omphalia chromacea* Cleland, Toadstools and Mushrooms and Other Larger Fungi of South Australia 1: 86. 1934.

Phytoconis ericetorum (Persoon:Fries) comb. nov.
=*Agaricus ericetorum* Persoon, Obs. Mycol. 1: 50. 1796. E.M. Fries, Syst. Mycol. 1: 165. 1821.
=*Byssus botryoides* Linnaeus, Species Plantarum, p. 1169. 1753.
=*Botrydina vulgaris* Brébisson, Mém. Soc. Acad. Agricol. Indust. & Instruct. Falaise, p. 36. 1839.
=*Agaricus pseudoandrosaceus* Bulliard, Herbier de la France, pl. 276. 1786.

Phytoconis lobata (Redhead & Kuyper) comb. nov.
=*Botrydina lobata* Redhead & Kuyper, Arctic and Alpine Mycology II, p. 334. 1987. Plenum Press, N.Y.

Phytoconis luteovitellina (Pilát & Nannfeldt) comb. nov.
=*Omphalia luteovitellina* Pilát & Nannfeldt, Friesia 5: 22. 1954.

Phytoconis velutina (Quélet) comb. nov.
=*Omphalia velutina* Quélet, C.R. Ass. franç. Av. Sci. (Grenoble, 1885) 14: 445. 1886.

Phytoconis viridis (Acharius) comb. nov.
=*Endocarpon viride* Acharius, Lichenogr. Univers., p. 300. 1810.

In addition to the specimens cited in our earlier paper it should be noted that an isotype of *Omphalia chromacea* Cleland has been located at Beltsville (BPI) and examined: South Australia, Mt. Lofty, 1/7/22, J.B. Cleland No. 178, on bare damp ground.

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MYCOTAXON

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A NEW SPECIES OF PEZICULA ON LEAVES OF PHYLLOCLADUS ASPLENIIFOLIUS IN TASMANIA

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ABSTRACT

A new species of *Pezicula* occurring on leaves of *Phyllocladus aspleniifolius* from Tasmania, Australia is decribed as *Pezicula tasmanica.*

A beautiful inoperculate discomycete which was collected in Tasmania, Australia and associated with a pycnidial fungus on thick, almost woody leaves of *Phyllocladus aspleniifolius* was kindly sent to us by Mr. Peter R. Johnston of the Plant Diseases Division, Department of Scientific and Industrial Research, Auckland, New Zealand (PDD). Although the species of *Pezicula* usually occur on bark or wood of higher plants (Wollenweber, 1939; Dennis, 1974; Hawksworth & Sivanesan, 1976; Korf, 1978; Remler, 1980), the apothecial structure of this fungus is similar to that of *Pezicula*, and does not recall the anatomy of *Pseudopezicula* Korf, a leaf-inhabiting genus of the Peziculoideae known only on leaves of the Vitaceae. This fungus is characterized by very small apothecia, short and very broad asci, and its occurrence on leaves. We describe it as a new species of *Pezicula.*

Pezicula tasmanica Zhuang & Korf, **sp. nov.** (Figs. 1)

Ab Peziculae speciebus aliis apotheciis parvis, foliicola, ascis latis, 74.6-87.7 x 20.5-24.3 µm.

Apothecium closely associated with a pycnidial fungus, erumpent from leaf epidermis, solitary, or two in a group, turbinate, sessile to subsessile, 200-300 µm in diam, hymenium pruinose when dry, light buff, receptacle concolorous. Ectal excipulum of textura prismatica to textura angularis, marginal cells club-shaped with a swollen and rounded apex, cell walls hyaline to subhyaline. Medullary excipulum of densely arranged textura intricata to textura angularis, cell walls hyaline to subhyaline. Subhymenium indistinguishable. Asci inoperculate, 8-spored, clavate to club-shaped, hemiamyloid, pore J+ (red) in Lugol's solution (IKI), J— in Melzer's reagent without KOH pretreatment, J+ (pore walls strongly blue) in Melzer's reagent with 2% aqueous KOH pretreatment, 74.6-87.7 x 20.5-24.3 µm. Ascospores irregularly uniseriate, ellipsoid to slightly reniform, unicellular, hyaline, becoming 3-septate and slightly pigmented when fully mature, 18.3-26.5 x 7.3-10.2 µm. Paraphyses filiform, slightly enlarged at apex, up to 3.5 µm at apex, 1.5-2.0 µm below, not exceeding asci.

Habitat: Mostly on the lower leaf surface of *Phyllocladus aspleniifolius*.

Holotype: associated with fruit bodies of a pycnidial fungus on leaves of *Phyllocladus aspleniifolius,* Pine Track, Tayatea Rd., Arthur River, Tasmania, Australia, P. K. Buchanan & A. Mills, 16. V. 1987, CUP 61818; PDD (isotype).

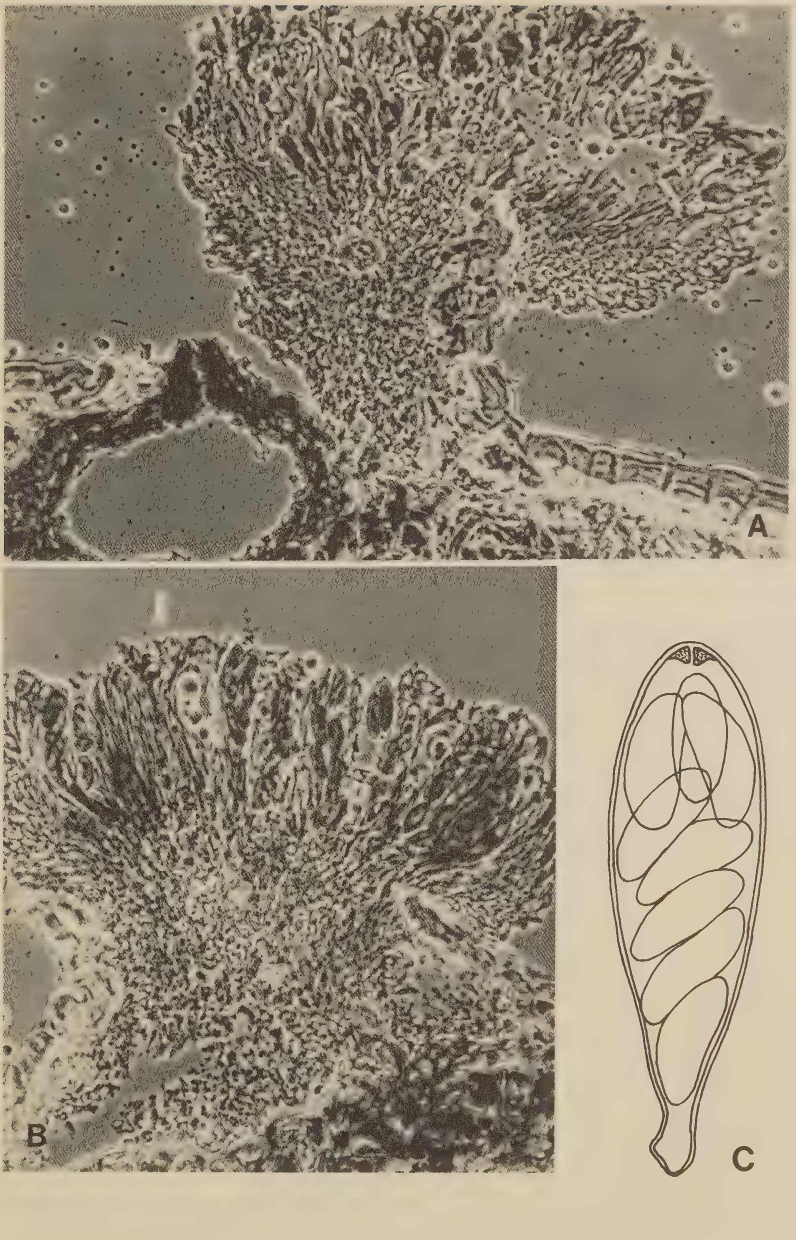
Notes: The presence of anamorphs of *Pezicula* species, ranging from acervulate to pycnidial, has been reported previously (Groves,1938, 1939, 1940, 1947; Wollenweber, 1939). Apothecia of the new species occurred directly on pycnidia which were in the leaves. The pycnidia had dark brown, well-developed walls but conidiogenous cells and conidia were very difficult to detect in sectioned preparations, perhaps because the pycnidia were overmature. Some ellipsoid, hyaline, catenulate conidia were found in squash mounts of a few pycnidia. Whether the *Pezicula* and the pycnidial fungus are mycoparasite and host, or whether they are teleomorph and anamorph (representing one holomorph) cannot be determined without cultural studies.

The substrate, leaves, is certainly unusual in *Pezicula*, characterized by occurrence on branches and stems of woody plants, *Rubus*, etc. The leaves of *Phyllocladus* are exceptionally tough and rigid.

ACKNOWLEDGEMENTS

We thank deeply Mr. P. R. Johnston (PDD) for providing this interesting fungus for our studies, Dr. W. J. Dress, Bailey Hortorium, Cornell University for correcting the Latin diagnosis, Dr. Linda M. Kohn, Department of Biology, University of Toronto-Erindale for serving as pre-submission reviewer, and Mr. K. E. Loeffler, the Department of Plant Pathology, Cornell University for preparing photographs.

Fig. 1. *Pezicula tasmanica*: A. photograph of a transverse section of an apothecium associated with a pycnidial fungus, B. photograph of a transverse section of an apothecium erumpent from leaf tissue, C. line drawing of a young ascus with ascospores, and hemiamyloid ascus apex; A, B x 240, C x 836; all from holotype.


A
B
C

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NOTES ON THE CULTURAL CHARACTERS, MORPHOLOGY AND DISTRIBUTION OF RIPARTITELLA BRASILIENSIS

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Summary

A description of *Ripartitella brasiliensis* (Tricholomataceae) is provided along with a description of its characters in culture. This species is a white-rot fungus found on hardwoods and has a tetrapolar mating system. It occurs throughout the tropics and subtropics.

In the following description, color comparisons in parentheses were made using Kelley (1965) or Kornerup and Wanscher (1978). Culture studies were performed on commercial BBL Malt Extract Agar and BBL Potato Dextrose Agar and cultures were incubated at 25 ° C. Culture morphology was determined following Nobles (1965) and Stalpers (1978). The species code given is that of Nobles (1965) and the key pattern of Davidson *et al* (1942). Procedures and chemical formulas for the spot tests are found in Stalpers (1978) and Marr (1979). All collections are deposited at NO unless otherwise noted.

Ripartitella brasiliensis (Speg.) Singer, Lilloa 22: 452. 1951.
≡*Pleurotus brasiliensis* Speg., Bol. Acad. Nac. Cienc. Cordoba 11: 20. 1889.
=*Marasmius squamosidiscus* Murr., Bull. Torrey Bot. Club 67: 151. 1940.
=*Lentodium floridanum* Murr., Mycologia 35: 426. 1943.
[=*Ripartitella squamosidisca* (Murr.) Sing., Lloydia 9: 128. 1946. nom. illeg.]
=*Ripartitella squamosidisca* (Murr.) Sing., Mycologia 39: 85. 1947.

=Collybia pseudoboryana Dennis, Trans. Brit. Mycol. Soc. 34: 453. 1951.
=Lepiota armillarioides Dennis, Kew Bull. 7: 486. 1952.

Figs. 1-8

Pileus 10-60 (70) mm wide, hemispheric to convex when young, expanding to broadly convex or nearly plane, the edge incurved when young, straight or wavy when mature, the edge appendiculate with fibrillar flaps for a short period after expansion begins, surface dry, matted-wooly and medium vinaceous-reddish brown (7D4-7E5, 58 m. Br.) overall on unopened or recently opened buttons, after expansion the center remaining matted-wooly and brown, elsewhere with tiny (0.5 mm), brownish fibrillar-squamular tufts, the squamules becoming distantly spaced and smaller toward the edge where finally nearly glabrous, glabrous in between the squamules, ground color whitish buff and not discoloring; context 1.5-3 mm thick, whitish buff, odor nondescript, taste slightly nondescript.

Lamellae 2-4 mm wide, more or less adnate, ivory white, not discoloring, entire, close; lamellulae numerous but not arranged in distinct tiers.

Stipe 15-50 mm long, 2-6 mm thick, equal, surface covered with small, distantly spaced, brownish, erumpent, fibrillar squamules up to a slightly fibrillar-annular zone near the apex, the squamules less evident in age, glabrous above, silky-fibrillose in between squamules, ground color whitish buff; context solid, whitish buff; often with a copious whitish, cottony mycelium at the base where attached to the substrate.

Veil fibrillar-membranous, brownish on the outer surface, remnants present as stated in pileus and stipe descriptions.

Chemical color reactions: 2.5% KOH no reaction, 10% NH_4OH pale grayish green on brownish areas of pileus (only one collection tested).

Spores white in deposit, 4.6-5.8 x 3.5-4.0 (4.6) µm, broadly elliptic to subspherical in profile and face view, finely echinulate, 1 or 2-guttulate, hyaline, inamyloid, acyanophilous. Basidia 18-24 x 5.8-6.9 µm, 4-sterigmate, clavate, hyaline. Hymenial cystidia found mainly on the

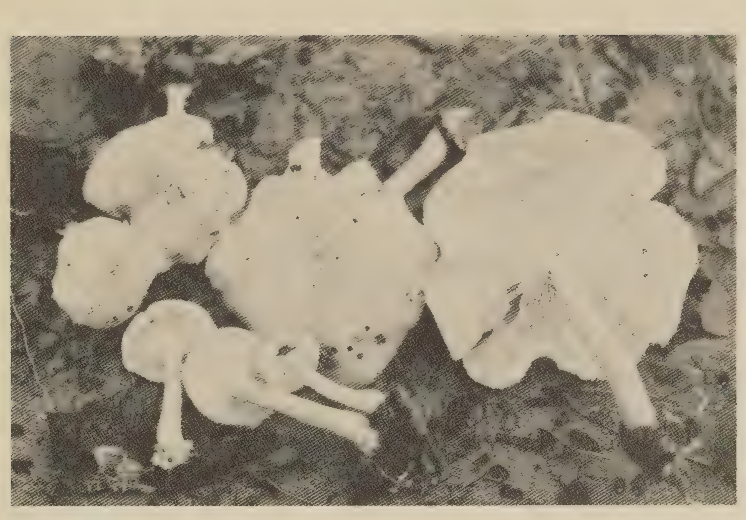


Fig. 1. Ripartitella brasiliensis (Ovrebo 1917). Carpophores, X .9.

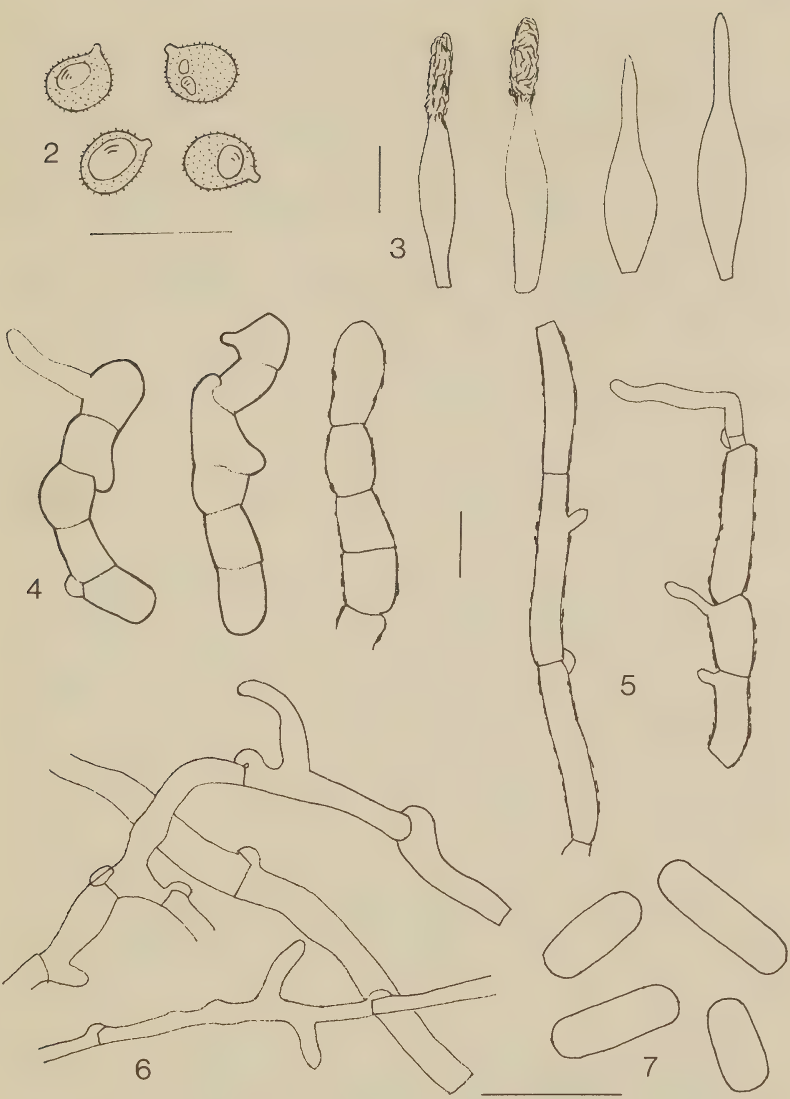
sides, 37-45 μm long, 6.9-8.1 μm wide at widest point, 2.3-3.5 μm wide at neck where not capitate, lageniform with generally a narrow base, capitate with crystalline-like ornamentation extending 6-10 μm down from the apex, the ornamentation dissolving quickly in 2.5% KOH and then appearing smooth-walled overall, the ornamentation more or less remaining intact in Melzer's reagent or water, thin-walled, hyaline, inamyloid. Caulocystidia at stipe apex, 11.5-52 (69) x 3.5-5.8 μm, intercalary or arising from recurved surface hyphae, cylindric, smooth, thin-walled, hyaline, scattered or in clusters. Hyphae of lamellar trama 3.5-17 μm wide, more or less parallel, cylindric to slightly inflated, hyaline. Hyphae of subhymenium 2.3-2.9 μm wide, scarcely differentiated as a layer, cylindric, hyaline. Hyphae of pileus cuticle 3.5-9.2 μm wide, interwoven at the center, elsewhere radially aligned except where in clusters, incrusted with rusty brown incrustations less than 0.5 μm thick, with narrow hyphal outgrowths extending from some cells, cells in clusters generally short (9-16 μm long), somewhat more inflated and darker pigmented than the repent surface cells which are cylindric and longer (12-40 μm), rusty brown as a layer. Hyphae of pileus trama 4.6-17 μm wide, cylindric to slightly inflated, hyaline, the walls slightly refractive. Hyphae of stipe surface 3.5-8.1 µm wide, longitudinally aligned but in places forming clusters, cylindric, smooth and thin-walled or with brownish incrustations, the cells in the clusters most heavily pigmented, narrow hyphal outgrowths present on some cells. Hyphae of stipe trama 3.5-25 µm wide, parallel, compacted, cylindric to slightly inflated, hyaline, walls slightly refractive. Hyphae of veil 3.5-6.9 µm wide, cylindric, smooth and thin-walled or with brownish incrustations. Hyphae on stipe base 2.9-5.8 µm wide, cylindric, smooth, thin-walled, hyaline. Clamp connections present throughout the carpophore.

Densely gregarious on downed hardwood logs, frequently on Quercus, one collection found on well-rotted bracket fungus; July - December on U.S. Gulf Coast. Subtropical and tropical, the latter being both in lowland and montane regions.

Collections studied:

U.S.A.: Florida: Alachua Co.: Gainesville, 4 Jul 1943, W. A. Murrill, Univ. of Florida Campus, Gainesville, 9 Aug 1985, Halling 4504 (both NY), 8 Nov 1938, W. A. Murrill, F 19126, 6 Sep 1939, W. A. Murrill, F 19955, 14 Sep 1938, W. A. Murrill, F 32694; Santa Fe, 13 Jul 1938, W. A. Murrill, F 17876 (holotype, Lentodium floridanum); Grove Park, 15 Jul 1938, West, Arnold & Murrill, F 18262 (holotype, Marasmius squamosidiscus, FLAS & isotype, NY); Sanchez Hammock, 23 Jul 1938, West & Murrill, F 17959 & 8 Aug 1938, West & Murrill, F 18035; Juniper Springs, 6 Sep 1939, A. S. Rhoads, F 20084 (all FLAS except where noted). Leon Co.: Botany Place, Tallahassee, 10 Aug 1983, G. Wright 3065. Louisiana: St. Tammany Par.: Crawford's Landing, Slidell, 18 Jul 1985, Ovrebo 1803. Tangipahoa Par.: Zemmuray Gardens, near hwy 10, 16 Nov 1985, Ovrebo 1929. Mississippi: Perry Co.: Black Creek, 6 Dec 1986, Ovrebo 2574. Texas: Hardin Co.: Jack Gore Baygall Unit, Big Thicket Natural Preserve, 26 Oct 1985, Ovrebo 1917 & 1918 & 1 Aug 1982, Lewis 3239; Lance Rosier Unit, Big Thicket Natural Preserve, 10 Jul 1976, Lewis 380. Orange Co.: 455 Virginia Lane, Vidor, 6 Aug 1979, Lewis 1878.

Caribbean region: Martinique: Mahogany Plantation, 23 Jan 1982, J. P. Fiard 1505. Trinidad: Tucuche Trail on Naranja, 2 Oct 1949, Dennis 116 (holotype, Collybia pseudoboryana); Sangre Grande, 11 Oct 1949, Dennis 159 (holotype, Lepiota armillarioides) (all K).



Figs. 2-7. Ripartitella brasiliensis. 2. Basidiospores (Ovrebo 1803). 3. Hymenial cystidia (Ovrebo 1803). 4. Hyphae from clusters on pileus surface (Ovrebo 1829). 5. Repent surface hyphae (Ovrebo 1829). 6. Hyphae from culture (Ovrebo 1803). 7. Arthrospores from culture (Ovrebo 1803). Scale line = 10 μm.

South America: Bolivia: Beni, Vaca Diez, Riberalta, 30 March 1956, R. Singer B2339 (F). Brazil: Apiahy, May 1988, J. Puiggari 2886-2888 (holotype, Pleurotus brasiliensis, LPS). Colombia: Departamento Antioquia: Municipios Puerto Triunfo/Sonson, 1-2 km E of Rio Claro, 8 Nov 1986, Ovrebo 2453; Municipio San José: between San José de la Montaña & Labores, 26 Nov 1986, Ovrebo 2551 (both HUA, NY, NO).

Africa: Kenya: W. Prov.: Kakanuga Forest, 25-27 Jan 1973, L. Ryvarden. Tanzania: Tanga Prov.: Magamba Reserve, 23 April, 1968, D. N. Pegler T654 (both K).

Western Pacific: Bonin Islands: Chichijima Island: Nagatami, 26 Nov 1977, Hongo B-224 (K).

Culture characters:
Culture examined: Ovrebo 1803 (NO, CFMR)
Species code: 2.3.7.35.36.38.47.54.60; key pattern: A-P-S-1-4-5-10.

Growth characters: Growth slow on MEA, 2.5-4 mm per week, 16-26 mm radius after 6 weeks, growth on PDA 6.5-7.5 mm per week, 40-45 mm radius after 6 weeks, margin even, raised and downy, white; mat thin downy, white; reverse unchanged; no odor detected; not fruiting within 6 weeks; gum guaiac solution: +; 0.1 M α-naphthol: +; syringaldazine: + (last 2 for laccase); 0.1 M cresol: -; tyrosine: - (last two for tyrosinase); α-naphthol phosphate: + (phosphatase); gallic and tannic acid agars no growth and no reaction.

Microscopic characters: Submerged and aerial hyphae thin-walled, occasionally swollen slightly in places, hyaline, nodose septate, often branched, 2.3-6 μm wide; thallic arthrospores cylindric to doliform with rounded ends, 6.9-13 x 2.9-3.5 μm, smooth, thin-walled, abundant in aerial mat.

Mating studies: The fungus is heterothallic with tetrapolar incompatibility system. The distribution of mating types among the monosporous isolates is as follows: A_1B_1 = 1, 8; A_1B_2 = 11, 12, 15; A_2B_1 = 2, 3, 4, 5, 9; A_2B_2 = 6, 7, 10, 13, 17. Clamp connections were found at the mating zone of compatible crosses but none were found in the new growth at the periphery of the same culture. Tissue explants of clamped hyphae from the mating zone formed stable-clamped mycelium in newly grown cultures.

Observations: Ripartitella brasiliensis is easily recognized by its small stature, tiny brown squamules on the pileus and stipe, and by its fruiting habit which is generally densely gregarious. Distinctive microscopic characters are the echinulate spores, capitate cystidia and make-up of the pileus surface. The capitate material on the cystidia dissolves in a matter of minutes in 2.5% KOH and the entire cystidium then appears smooth. The capitate material remains intact in water or Melzer's reagent. The cystidia are always present but are abundant in some collections while rare in others. It is the latter that has caused some workers (Dennis, 1951; Horak, 1968; Pegler, 1977, 1983) to report that they are absent. As noted by Singer (1946) and Pegler (1977, 1983), the pileus surface is composed of two cell types: (1) repent surface hyphae composed of long and narrow cells which are generally incrusted (Fig. 5), and (2) squamular hyphae composed of short, cylindric to slightly inflated cells that are slightly thick-walled and smooth or incrusted (Fig. 4). Both cell types are also found on the stipe. Commonly, there are narrow hyphal outgrowths from both these cell types that are smooth and narrower than the cells from which they arise (Figs. 4 & 5). These narrow outgrowths represent new growth from what otherwise appear to be differentiated cells.

As seen from the synonomy, Ripartitella brasiliensis has been described as a new species in a number of genera. It most truly, however, resembles a Lepiota due to the aspect of the pileus surface and presence of a veil. The latter is easily separated by having free lamellae and smooth, dextrinoid spores. In contrast to Singer (1986), who places Ripartitella in the Agaricaceae, this author agrees with Pegler (1977) that the genus is properly placed in the Tricholomataceae.

Ripartitella brasiliensis is known to date from a number of locations throughout the tropics and subtropics (Fig. 8) from both lowland and montane habitats. Records to date reveal that it occurs on angiosperm dicotyledonous wood. It is associated with white rot decay. Further collecting may show that it is widely distributed throughout the tropical and subtropical belts.

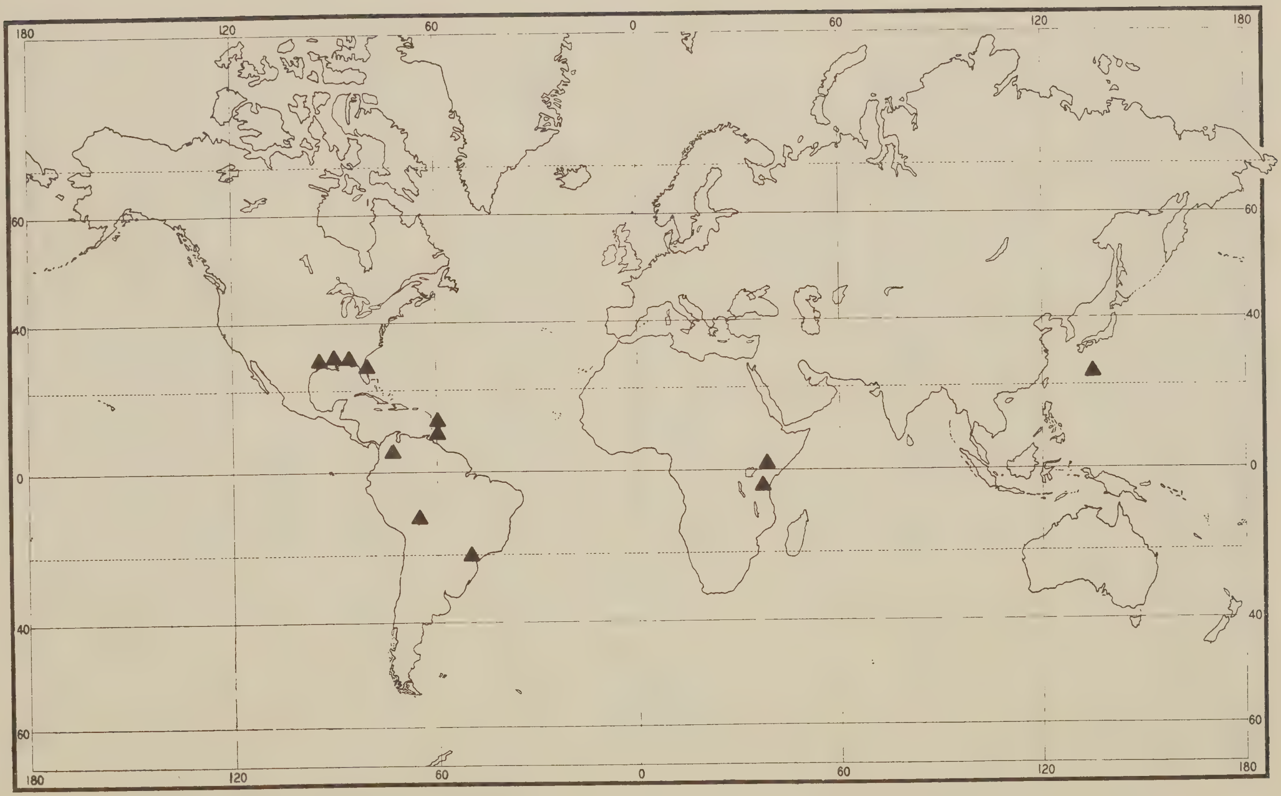

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Fig. 8. Distribution of *Ripartitella brasiliensis*.

Acknowledgements

Thanks are extended to the following institutions and individuals for the loan of specimens: K, LPS, NY, F, FLAS, Greg Wright and David P. Lewis. Meredith Blackwell and Karen Nakasone assisted in the analysis of the culture characters. Field work in Colombia was made possible through an NSF grant (# BSR-860024) to Roy E. Halling.

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LAZUARDIA, A NEW GENUS FOR PEZIZA LOBATA

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ABSTRACT

The globose spored and bluish species *Peziza lobata* (with its synonyms *Peziza verruculosa* and *Barlaeina albocaerulescens*) is made the type of a new operculate genus *Lazuardia*. The combination *Lazuardia lobata* is proposed for this rare but widely distributed species and an illustrated description is presented as well.

The globose spored *Peziza lobata* Berk. & Curt. and its many synonyms seems to defy any attempt to place it in the existing genera of operculate cup fungi. A new genus solely proposed to accommodate this species would appear appropriate, but since the generic delimitations of Pezizales involving globose spored species have always been a source of disagreements among discomycetologists a brief explanatory justification would be required for establishing such a genus.

Based on a specimen from Cuba, *Wright 652*, this species was originally introduced into mycological literature by Berkeley (1868) with distinguishing characters which read "... hymenio rufo hic illic cribroso, subtus pallidioribus sporidiis globosis ...." Since field notes were not available until quite recently, the pigmentation and the appearance of this species in fresh conditions were unknown and consequently its true affinity has always been in doubt. It became dull orange and later on pale yellow when Seaver (1914, 1928) redescribed it, a typical field character of species of *Lamprospora* de Not. where Seaver classified this species. Using Seaver's treatise as a guide, Thind & Waraith (1971) reported an Indian collection of this species which was stated to have a pure white hymenial surface.

The same species was described again from Ceylon as *Peziza verruculosa* by Berkeley & Broome (1873) who diagnosed it only microscopically ("... ascis linearibus; sporidiis uniseriatis globosis fortiter verruculosis, paraphysibus linearibus intus globulis repletis ..."). For its macroscopic characters they simply added "... caetera *P. hirtae* ..." Neither substrate, nor habitat, nor specimen were indicated but luckily Berkeley left an annotated specimen behind. The comparison with *Scutellinia hirta* was totally misleading -- obviously it led Saccardo (1889) to compile it as *Sphaerospora verruculosa*, but there is nothing to suggest their resemblance whatsoever. This matter was later cleared up by Petch (1916).

There was apparently some mix-up during the preparation of the description of *Peziza sarmentorum* Berk. & Br. var. *geophila* Berk. & Br., because although the spores were said to be "... 0.0008 long, 0.0004 wide ..." the type specimen indicated (*Ceylon Fungi 1055*) was found to have globose spores typical of the present species. The synonymy of *Peziza sarmentorum* var. *geophila* to *Peziza lobata* was already known to Cook (1877). This synonymy was accepted by Saccardo who did not specifically list *Peziza sarmentorum* var. *geophila* as a synonym of *Peziza lobata* but by citing the illustration published by Cook he did give the geographic distribution of the present species as Cuba and Ceylon. *Peziza sarmentorum* Berk. & Br. itself is a petiole-inhabiting helotioid species.

The true bluish pigmentation of the present species when fresh was first given by Penzig & Saccardo (1901) when they described and later (Penzig & Saccardo 1904) illustrated *Barlaeina albocaerulescens* Penz. & Sacc. based on a specimen collected by Max Fleischer in Java. Petch (1916) also observed that when fresh the field characters of the Ceylonese *Peziza verruculosa* were identical with the Javanese form so that he synonymized them. With regard to the Cuban collection Petch stated that "... if colour given for *B. lobata* in the published description is correct, the Ceylon species is immediately distinguishable ..." thus indicating his belief on the taxonomic importance of the pigmentation. In recording the specimen from Trinidad, Dennis (1954) noted in the caption of his illustration that the fresh colour of this species was still uncertain. Due to these inconclusive evidences and because only a casual examination was undertaken, it was only tentatively that in a former study (Rifai 1968) all the species involved were regarded to be identical.

A more recent new world collection from Trinidad made by Dr. D. A. Reid of the Herbarium of the Royal Botanic Gardens Kew in 1973 was available for further study and fortunately it was accompanied by ample field notes which record that when fresh the colour of the apothecia is "...white to bluish white inside, white to yellowish white outside...". With this new evidence and because microssopically there is nothing to distinguish them I am now convinced that *Peziza lobata*, *Peziza verruculosa*, *Peziza sarmentorum* var. *geophila* and *Barlaeina albocaerulescens* are the same species.

As has been indicated earlier (Rifai 1968) the presence of hairs on the surface of the receptacle makes this species not wholly acceptable to the *Barlaeina* – *Marcelleina* – *Pulparia* complex where Saccardo and Petch would place it. Admittedly the hairs are delicate and hyaline so that their presence has escaped the detection of earlier workers, the only other mention of their existence being that of Thind & Waraith (1971). Their size and distribution pattern on the surface of the apothecia, however, is similar to those of other typical hairs found in the suborder Pezizineae, namely they are more numerous, longer but narrower towards the margin of the cup.

Similarly the classification of the present species in *Lamprospora* as has been done by Seaver (1914, 1928), Boedijn (1951), Dennis (1954) and more recently by Thind & Waraith (1971) is out of the question largely because of the marked differences in macroscopic habit of the apothecia, their consistency, excipular structure, anatomy of the apothecial margin as well as the disc pigmentation. Blue being rare in fungi, this character may have a more important diagnostic value than the presence of the hair. It is with this idea in mind that I make this bluish species the type species of a new genus which is proposed to be called *Lazuardia* Rifai.

Lazuardia Rifai, *gen. nov.*

Apothecia gregaria, mediocria, sessilia, denique discoidea, disco caerulescentes, extra tomentosa ex pilis hyalinis septatis composita. Excipulum ectale e cellulis angularibus (textura angularis), excipulum medullare ex hyphis septatis (textura intricata) compositum. Asci cylindracei, apice operculati jodo haud tincti, octospori. Ascospori uniseriati, hyalini, globosi, ornati, uniguttulati. Paraphyses septatae, rectae, filiformes. Species typica generis: *Peziza lobata* Berk. & Curt.

Lazuardia lobata (Berk. & Curt.) Rifai, *comb. nov.*

Peziza lobata Berk. & Curt. *apud* Berk. *in* J. Linn. Soc. (Bot.) 10: 365. 1868 (basionym). --*Barlaea lobata* (Berk. & Curt.) Sacc., Syll. Fung. 8: 117. 1889. --*Barlaeina lobata* (Berk. & Curt.) Sacc. & Trav. *in* Sacc., Syll. Fung. 19: 140. 1910. --*Lamprospora lobata* (Berk. & Curt.) Seaver *in* Mycologia 6: 22. 1914.

Peziza sarmentorum Berk. & Br. var. *geophila* Berk. & Br. *in* J. Linn. Soc. (Bot.) 14: 102. 1873.

Peziza verruculosa Berk. & Br. *in* J. Linn. Soc. (Bot.) 14: 105. pl. V, fig. 23. 1873; non *Peziza verruculosa* Berk. & Curt. *in* Proc. Amer. Acad. 4: 127. 1860. --*Sphaerospora verruculosa* (Berk. & Br.) Sacc., Syll. Fung. 8: 189. 1889. --*Barlaeina verruculosa* (Berk. & Br.) Petch *in* Ann. R. Bot. Gard. Perad. 6:

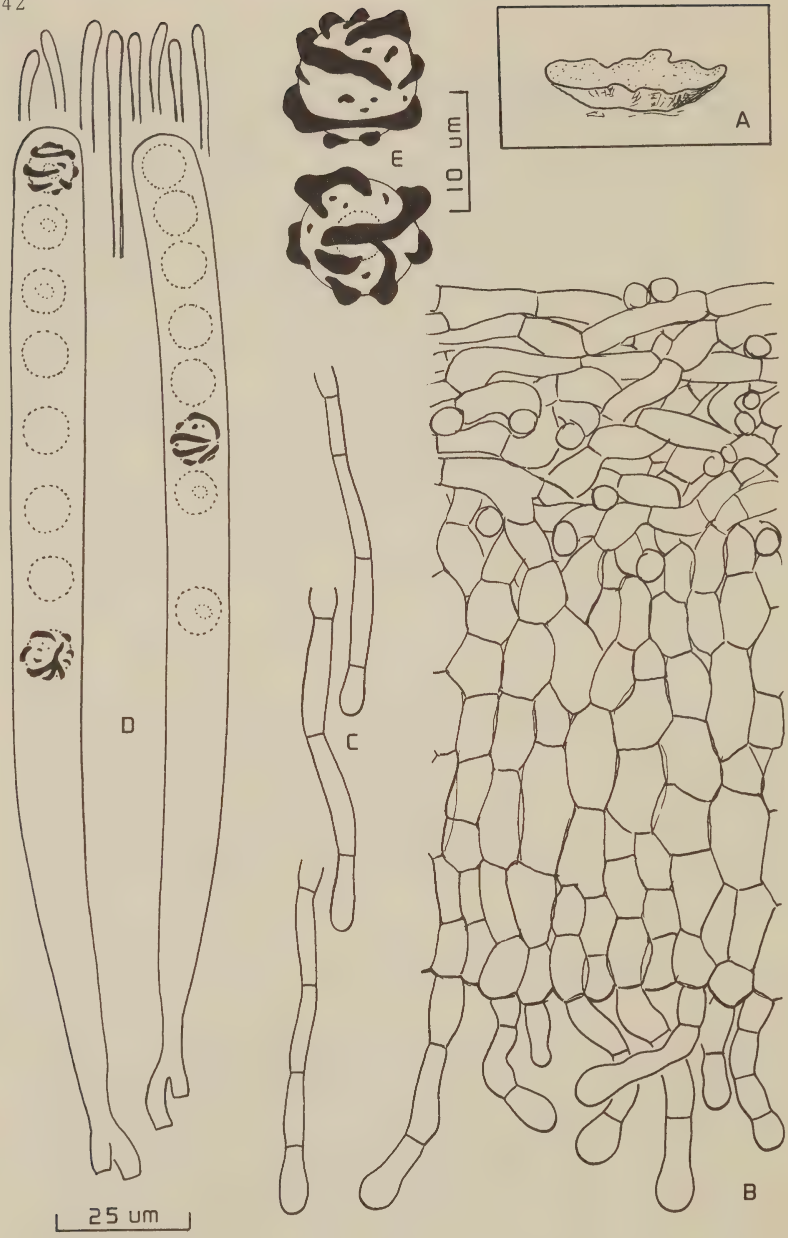
A
B
C
D
E
10 um
25 um

Fig. 1. *Lazuardia lobata*.--A. Habit sketch. B. Diagrammatic section of ectal and medullary excipulum. C. Hairs. D. Asci and paraphyses. E. Ascospores.

169. 1916 (ut *Barleina*). —*Lamprospora verruculosa* (Berk. & Br.) Boedijn *in* Sydowia 5: 211. 1951.

Barlaeina albocaerulescens Penz. & Sacc. *in* Malpighia 15: 202. 1901; Icon. Fung. Jav. :67, tab. V, fig. 4. 1904.

Apothecia scattered to gregarious, occasionally caespitose, sessile, up to 2.5 cm diam. Disc at first distinctly concave, later on wavy to almost flat, smooth, bluish white (?fading) to pure white. Receptacle when young deeply cupulate, becoming shallowly cup shaped in age, irregularly undulated or lobed at the margin, white to yellowish white, finely tomentose especially towards the edge, with a fleshy consistency. The tomentomes consist of delicate but well differentiated hairs which are hyaline, flexuous, smooth and thin walled, septate, subcylindrical but distinctly enlarged towards their apex, 4-8 um diam. and up to 75 um long, those near the margin of the cup longer but narrower than the rest. Ectal excipulum up to 120 um thick, of compacted prosenchymatous tissue to form a textura angularis pseudoparenchyma with polygonal elongated cells up to 36 um long by 18 um wide, arranged with their long axis at right angles to the surface of receptacle. Medullary excipulum well developed, made up of tightly interwoven, septate and branched hyaline hyphae (textura intricata), 4.5-8(-12) um in diam., slightly thinner walled compared to those of the ectal excipulum. Subhymenium of compacted isodiametric, rounded or polygonal cells, interspersed with short celled hyphal elements. Hymenial layer about 250 um thick. Asci cylindrical and clearly attenuate towards the base, 8-spored, up to 255 um long by 11-15 um diam., apex or walls not blued in Melzer's reagent. Ascospores uniseriate, globose, hyaline, uniguttulate, at first smooth but soon becoming ornamented with 4-6 irregularly orientated, wavy, rarely anastomosing broad band-like ridges of various length and uneven thickness up to 2.8 um high; without the ornamentation the ascospores measure 8.4-11.4 um in diam. Paraphyses straight, sparingly septate, slender, 1.5-2 um diam. and only slightly enlarged at the apex to about 2.8 um diam., projecting to about 30 um beyond the ascus tip.

Habitat and distribution: on the ground in Ceylon, India, Java, Sumatra, Cuba, Jamaica and Trinidad.

SPECIMENS EXAMINED: AMERICA. Cuba. On the ground, s. dat., *Wright 652* (K, type of *Peziza lobata* Berk. & Curt.); on the ground, s. dat., *Wright s.n.* (K, paratype of *Peziza lobata* Berk. & Curt.)-- Trinidad. On sandy soil in forest, Quinan, 4 November 1949, *R.E.D. Baker s.n.* (K); on (?burnt) soil with fragments of mica and schist, Mt. Benedict, Tunafuna, 31 August 1973, *D.A. Reid s.n.* (K). -- Jamaica. On earth in woods, 18 February 1928, *C.R. Orcutt 4226* (K).

ASIA. Ceylon. On the ground, Peradeniya, December 1868, *s. coll. 1055* (K, type of *Peziza sarmentorum* Berk. & Br. var. *geophila* Berk. & Br.); on the ground, s.dat., s. coll. (K, type of *Peziza verruculosa* Berk. & Br.); on the ground, Gangarua, December 1913, *Petch 4100* (K); on the ground, Peradeniya, November 1914, *Petch 4337* (K). -- India. On soil under teak and pine, Kalimpong Rd from Tiste, Darjeeling, 22 July 1964, *K.S. Thind 352* (K). -- Java. On soil, Cibodas, Mt. Gede, 1897, *M. Fleischer 934* (BO 2680, type of *Barlaeina albocaerulescens* Penz. & Sacc.); on the ground, Bogor Botanic Gardens, April 1926, *Nongnong s.n.* (BO 1023). -- Sumatra. Batang Palupuh, 1000 m alt., July 1924, *E. Jacobson s.n.* (BO 9246).

I should like to thank the Keeper of the Herbarium of the Royal Botanic Gardens Kew for research facilities put at my disposal in 1978 and to Dr. R. P. Korf of Cornell University for kindly going through the manuscript.

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MYCOTAXON

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ARACHNOPEZIZA OCHRACEA COMB. NOV. AND A NEW SYNONYM OF POLYDESMIA PRUINOSA

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ARACHNOPEZIZA OCHRACEA

During type studies for her monograph of the genus *Strossmayeria* Schulzer, the senior author has examined the holotype specimen of *Belonidium ochraceum* Grelet & Crozals (**1929**), on deposit in Paris (PC). It is clearly neither a *Strossmayeria* nor a *Belonidium*, but proves to be a previously unrecognized species of *Arachnopeziza* Fuckel, a genus that has been a subject of the junior author's Ph.D. thesis and later studies (Korf, **1952, 1959, 1977, 1981**; Korf and Gruff, **1981**; Korf & Zhuang, **1985**).

The original description of *Belonidium ochraceum* fails to mention the presence of marginal hairs on the apothecia, and the presence of a scanty subiculum, which may account for its correct position being overlooked by all subsequent authors. The original description also disagrees in microscopic measurements of all features with those we obtained. It seems highly possible that Grelet used an incorrect calibration of his microscope when drawing up the description, as has previously been postulated by Korf (**1951**) in discussing the discrepancy in measurements between Grelet's description of *Arachnopeziza obtusipila* Grelet and its type specimen. By applying a correction factor of x 0.75 to the published microscopic measurements, Korf was able to get better agreement between the type specimen and the description. The type specimens of *A. obtusipila* and of *B. ochraceum* were both collected by A. de Crozals in December, 1927, and we now assume both descriptions were drawn up, perhaps at the same time, with the postulated incorrect calibration. Table I illustrates application of this correction factor to the microscopic measurements reported by these authors in comparison with their published figures and with those we obtained from the type specimen. The appreciably longer ascus and ascospore measurements of the original description, in particular, are in far better agreement with the type specimen after application of the correction factor. We found no asci or ascospores approaching the lengths recorded originally.

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TABLE I

BELONIDIUM OCHRACEUM GRELET & CROZALS

	Grelet	Iturriaga & Korf	Grelet x 0.75
Ascus width	8-10µm	7.5-9.3µm	6.0-7.5µm
Ascus length	75-105µm	(65.4-)72.8-85.8µm	56.2-78.8µm
Spore width	3-4µm	(2.0-)2.6-3.7(-4.0)µm	2.25-3.0µm
General spore width	3µm	2.6-3.7µm	2.25µm
Spore length	16-27µm	(14.6-)16.8-21.3µm	12.0-20.2µm
General spore length	18-25µm	16.8-21.3µm	13.5-18.8µm
Paraphysis width	2.5-3µm	1.5-2.2µm	1.9-2.3µm

The type collection of *Belonidium ochraceum* is only in a fair state of preservation, with some molds overgrowing the specimen. The fungus fruits on the cut end of a wood chip, which the original authors assumed may be *Pinus*. The subiculum is scanty, and the hairs are rather short for a typical *Arachnopeziza,* and are only obvious at the margin, where they form a whitish fringe. It is clearly a species unknown to the junior author, and a formal transfer and an emended description is provided here.

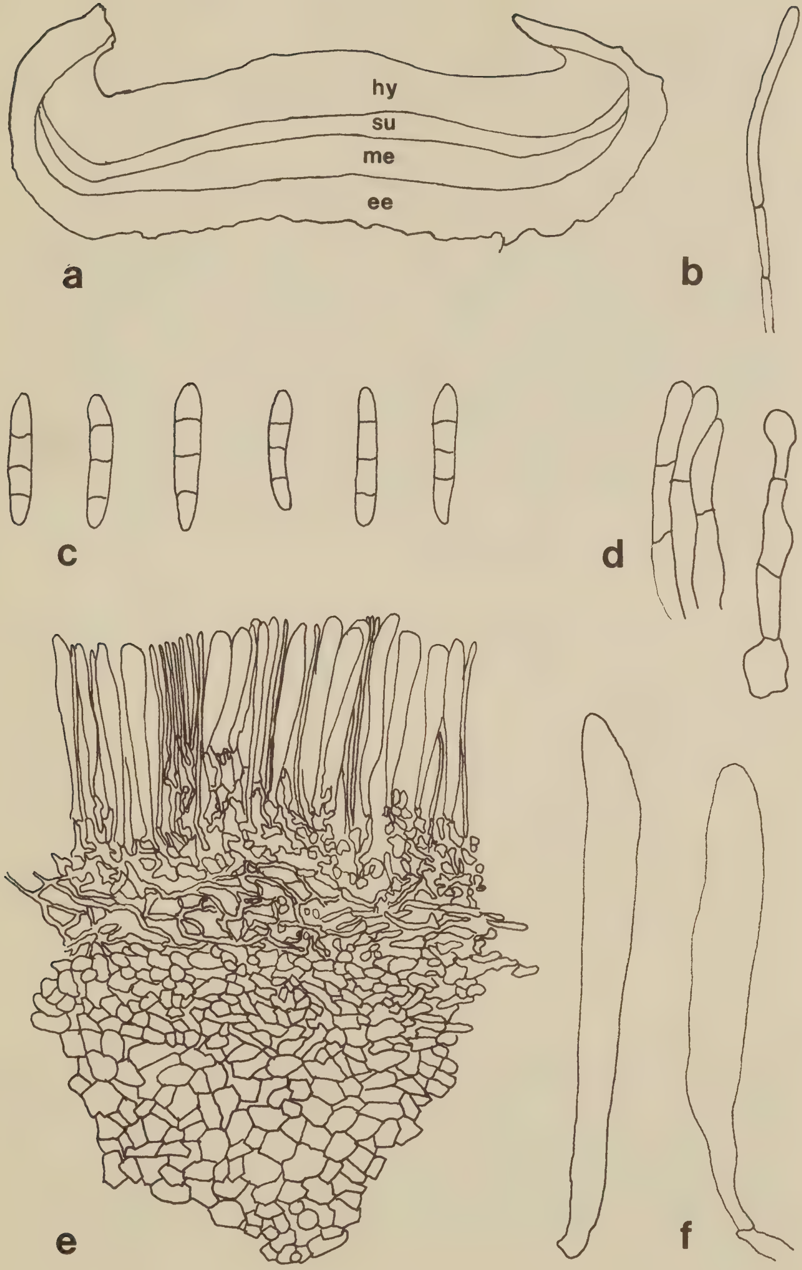
Arachnopeziza ochracea (Grelet & Crozals) Korf & Iturriaga, *comb. nov.* (FIG. 1)

≡ *Belonidium ochraceum* Grelet & Crozals, Bull. Soc. Mycol. France **44:** 274. 1929 (1928).

Apothecia cupulate, sessile, 1.0-1.5 mm diam, with a paler margin. *Disc* beige, granulose when dry. *Receptacle* reddish brown when dry, fringed with short hairs at the margin only. *Hairs* hyaline, several-septate, fairly thin-walled, tapering apically, apex rounded, (29.4-) 36.7-38.2 x (2.2-) 3.7 (-4.4)µm. *In section:* ectal excipulum of textura angularis, 36-75µm thick, cells (4.4-) 6.6-9.5 (-11.0) x 2.9-5.9 (-6.6)µm, hyaline except outermost cells near base may be yellowish, walls somewhat glassy; medullary excipulum of textura intricata, 37-47µm thick, hyphae 1.5-2.2(-2.9)µm wide; subhymenium not clearly distinguishable from medullary excipulum, up to 9.3µm deep. *Asci* 8-spored, clavate, but tapering toward the apex, provided with a J+ pore (with or without KOH-pretreatment), arising from repeating croziers, (65.4-) 72.8-85.8 x 7.5-9.3µm. *Ascospores* hyaline, biseriate, rarely triseriate, cylindric-fusiform, 3-septate at maturity, not constricted at the septa, (14.6-) 16.8-21.3 x (2.0-) 2.6-3.7 (-4.0)µm. *Paraphyses* equal in length to the asci, simple or rarely branched, 1.5-2.2µm wide.

CULTURAL CHARACTERS: Unknown.
HABITAT: Rotten wood, on cut surface, of *? Pinus*.
NAME: From Latin, *ochraceus* = color of apothecia when fresh.
TYPE LOCALITY: Toulon (Var), France.

FIG. 1. *Arachnopeziza ochracea,* drawn from holotype. a, diagrammatic transverse section of apothecium (hy = hymenium, su = subhymenium, me = medullary excipulum, ee = ectal excipulum); b, paraphysis apex; c, six ascospores; d, marginal hairs; e, portion of a transverse section; f, two asci. Magnifications: a, x 100; b, c, d, f, x 1000; e, x 400.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ILLUSTRATIONS: Grelet & Crozals, Bull. Soc. Mycol. France **44:** pl. 21, fig. 7; this paper, fig. 1.

EXSICCATI: None.

HOLOTYPE EXAMINED: *France:* A. de Crozals, sur bois pourri de pin (probablement), environs de Toulon (Var), Décembre 1927 (PC-Grelet).

POLYDESMIA PRUINOSA

The senior author's examination of the type specimen of *Belonium pyrenomycetum* Vel. has shown this to be a later synonym of the common pyrenomycete-inhabiting *Polydesmia pruinosa* (Jerd. *in* Berk. & Br.) Boud., as was already noted on the outer packet of the type specimen (PRM 149887). The outer and inner packets bear the date "VII.1928," while Velenovsky's (**1940**) original diagnosis gives the date as "julio 1935.' All the other data is in agreement. Since the junior author gave the date of publication of Boudier's combination as 1907 in his monograph (Korf, **1978**), we take this opportunity to point out the possibility that Boudier's earlier combination in 1904 may be considered valid by some authors despite the incorrect author citation. The problem also was noted in the junior author's compendium on names for the plates in Boudier's *Icones Mycologicae* (Korf, **1986**). The full, corrected synonymy of the species is:

POLYDESMIA PRUINOSA (Jerd. *in* Berk. & Br.) Boudier, Icon. mycol. Liste prélim. p. [4]. 1904 ('(Berk.) Boud.'); Hist. classific. discomyc. Europe p. 100. 1907 ('Berk. et Br.').

≡ *Helotium pruinosum* Jerd. *in* Berk. & Br., Ann. Mag. Nat. Hist., ser. 3, **18:** 127. 1866.

≡ *Pseudohelotium jerdonii* Sacc. (*'jerdoni'*), Syll. Fung. **8:** 296. 1889 [a name change, not *Ps. pruinosum* (Wallr.) Sacc. 1889].

≡ *Belonidium pruinosum* (Jerd. *in* Berk. & Br.) Rehm *in* Rabenh., Kryptogam.Fl. Deutschl., Oesterr. Schweiz, ed. 2, **1**(3) [Lief. 35]: 510. 1891; [Lief. 36]: 562. 1891.

≡ *Belonium pruinosum* (Jerd. *in* Berk. & Br.) Höhn. *in* Rehm, Ann. mycol. **10:** 536. 1912.

= *Belonium pyrenomycetum* Vel. (*'Pyrenomycetum'*), Novitates Mycol. p. 182. 1940 (1939).

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GANODERMA MEREDITHAE, A NEW SPECIES ON PINES IN THE SOUTHEASTERN UNITED STATES [1]

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SUMMARY

A new species, *Ganoderma meredithae*, is described from pines in the southeastern United States. It is distinguished from other species in the *G. lucidum* complex by its host specificity, often branched or lobed pilocystidia, plumose or feathery growth habit in culture, optimum growth temperature of 25-30 C with growth at 35 C, and lack of chlamydospores in culture.

In the course of research on North American species in the *Ganoderma lucidum* complex, we have obtained evidence for six distinct taxa. These are *G. lucidum* (W. Curt.: Fr.) Karst., *G. tsugae* Murr., *G. oregonense* Murr., *G. zonatum* Murr., *G. colossum* (Fr.) C.F. Baker, and a sixth species that is restricted to pines in the southern pine region (Adaskaveg and Gilbertson, 1986 a,b). For reasons detailed below, we have concluded that none of the names of described species of *Ganoderma* are applicable to this taxon and we therefore describe it as a new species.

Basidiocarp and cultural tissues were mounted in 4% KOH and phloxine or Melzer's reagent for microscopic examination. Drawings were made with a camera lucida on a Leitz Dialux microscope. Capitalized color names are from Ridgway (1912).

GANODERMA MEREDITHAE Adaskaveg and Gilbertson, sp. nov.

Fructificatio annua, sessili vel stipitata; superficies cremea vel luteo-bubalina ad initium, demum rubro-brunnea, crustosa vel laccata; pori 4-6 per mm; contextus pallido-bubalinus vel pallido purpureo-brunneus, cum zonae atropurpureo-brunnea, resinosa; systema hypharum dimiticum; hyphae generatoriae fibulatae; hyphae skeletales nonseptatae, crassitunicatae, cum ramos dendriticus; pilocystidia crassitunicatae, amyloidea, saepe ramosa vel lobata; basidia late clavata, 4-sterigmatibus, 22-26 X 13-16 µm; basidiosporae ellipsoideae, truncatae, pallido-brunnea, paries duplexis, cum columnae interparietis, 9.5-11.5 X 5.5-7.0 µm.

Holotypus: JEA 345, on *Pinus taeda* L., R. Summers, Pineville, Grant Parish, LA, Aug. 21, 1985; in herb. National Fungus Collections, Beltsville, MD.

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[1] - University of Arizona Agricultural Experiment Station Journal Article No. 4444

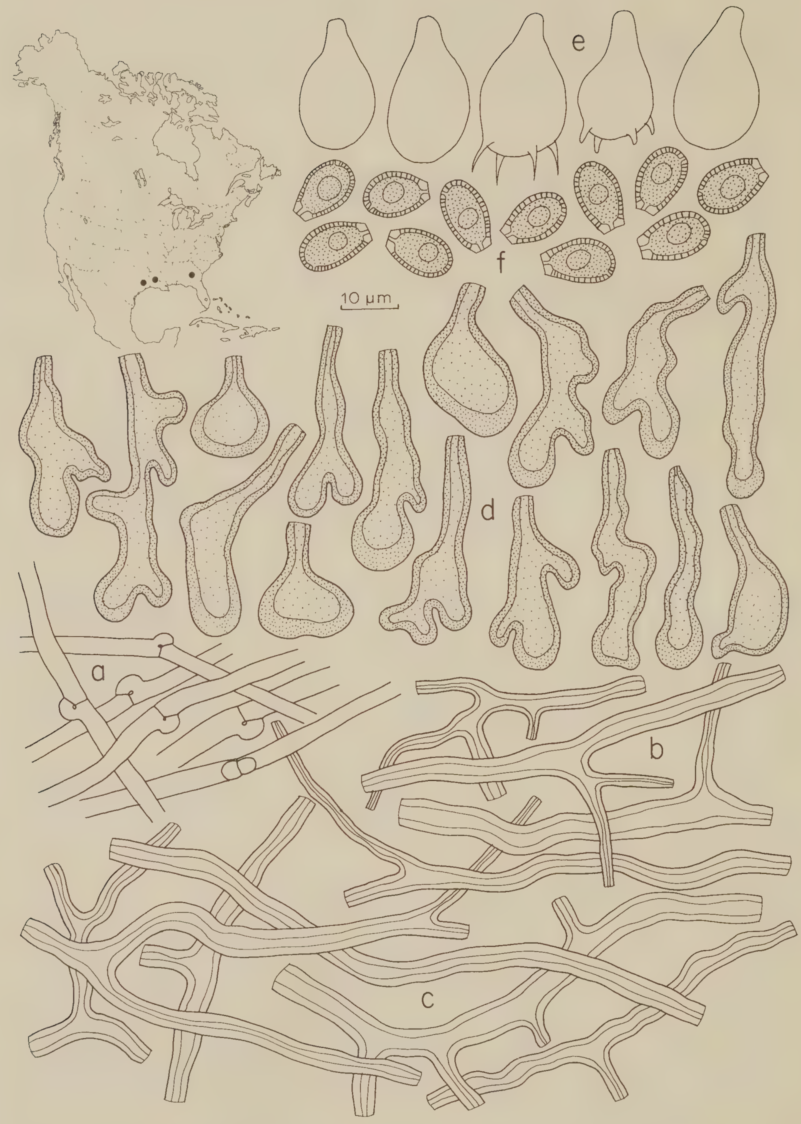

Fig. 1. Basidiocarp characteristics of *Ganoderma meredithae* (JEA 395, holotype). a, tramal generative hyphae; b, tramal skeletal hyphae; c, contextual skeletal hyphae; d, pilocystidia; e, basidia; f, basidiospores.

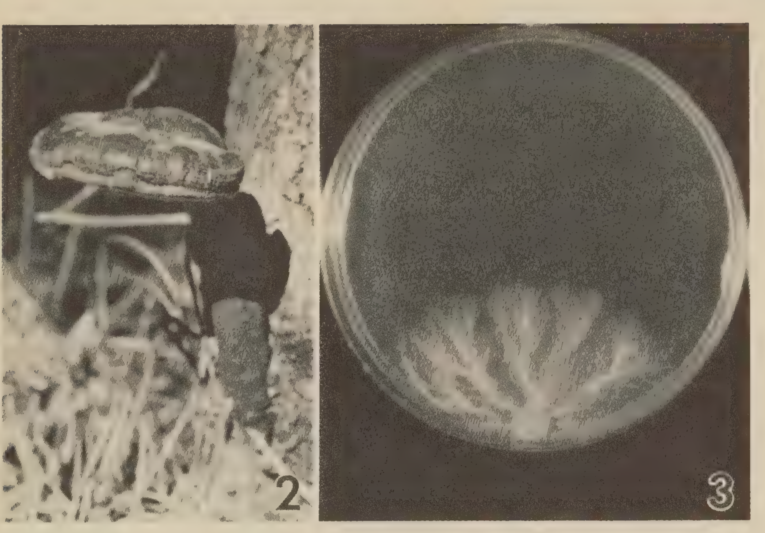

Fig. 2-3. *Ganoderma meredithae.* 2, basidiocarp at base of *Pinus taeda*; 3, one week-old culture on malt extract agar medium at 25 C (JEA 399).

Etymology: named for Dr. Meredith Blackwell of Louisiana State University, a student of Gulf Coast fungi.

Basidiocarps annual, sessile to centrally or laterally stipitate, developing at the base of living pines or on dead pines or stumps; pilei circular to dimidiate or reniform, up to 15 cm or more broad, upper surface cream colored to yellowish buff at first, becoming reddish brown, concentrically zonate and shallowly sulcate, glabrous, dull and crustose to shiny and laccate; pore surface creamy white at first, becoming pale vinaceous cream at maturity, pores circular to angular, 4-6 per mm, with thick, entire dissepiments that have a sugary appearance under a 30X lens; stipe central to lateral, up to 10 cm long and 3 cm thick, becoming dark maroon, shiny, and laccate, cut surfaces showing distinct dark zones of dense purplish brown tissue under an outer zone of uniformly pale buff tissue, in cross sections these dark zones appear as concentric rings; context light buff near the upper surface, grading to pale purplish brown toward the tubes, corky, usually with some darker resinous zones, up to 2 cm thick; tube layer light purplish brown, corky, up to 2 cm thick.

Hyphal system dimitic; contextual skeletal hyphae thick-walled, hyaline, nonseptate, faintly pigmented in mass, 2-6 µm in diam with frequent branching, tips often dendritically branched; contextual generative hyphae difficult to discern in mature specimens, thin-walled, hyaline, with clamps, 2.5-4.5 µm in diam; tramal hyphae similar, generative hyphae more obvious; pilocystidia forming a solid palisade on the pilear surface, moderately thick-walled, often much thicker-walled at the apex, strongly amyloid in Melzer's reagent, highly variable in shape from nearly spherical or reniform to clavate, often strongly branched or lobed, 17-50 X 6-15 µm.

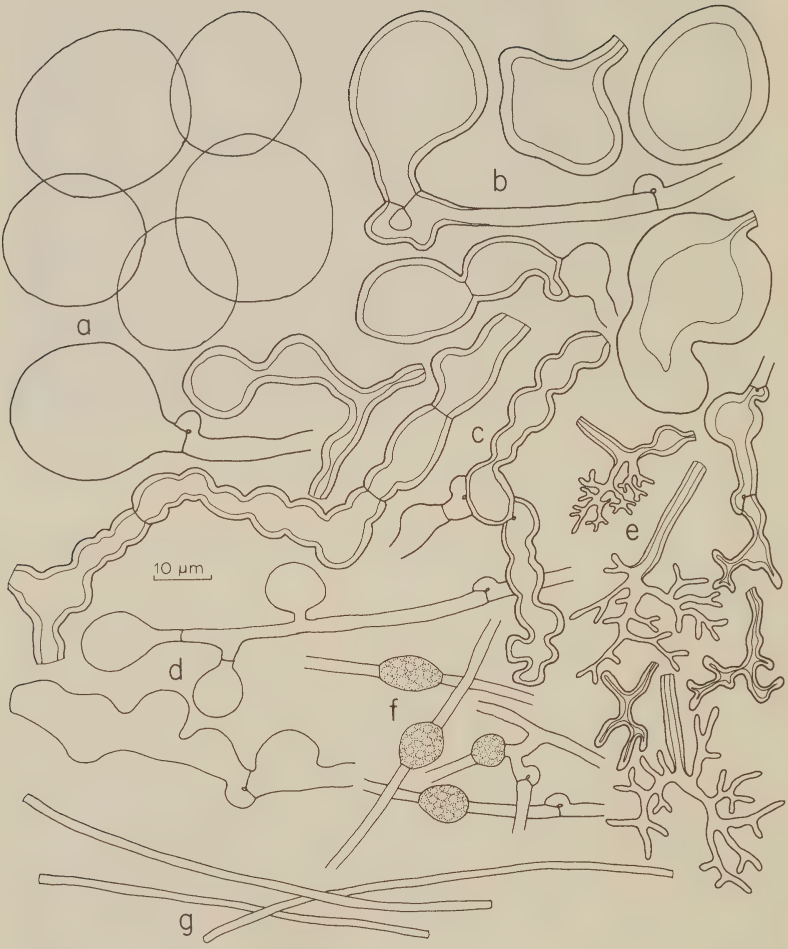

Fig. 4. Cultural characteristics of *Ganoderma meredithae* (JEA 395, holotype). a, thin-walled cuticular cells; b, thick-walled, amyloid cuticular cells; c, moniliform, amyloid, thick-walled hyphae; d, thin-walled hyphae with developing cuticular cells; e, staghorn hyphae; f, hyphal vesicles and generative hyphae; and g, fiber hyphae.

Cystidia or other sterile hymenial elements absent.

Basidia broadly clavate to subspherical, with a sharply narrowed base, 4-sterigmate, 22-26 X 13-16 µm.

Basidiospores ellipsoid, apex truncate with a germ pore, pale brown in KOH, wall two-layered with layers separated by inter-wall pillars, 9.5-11.5 X 5.5-7.0 µm.

Type of rot - White root and butt rot of living pines.

Substrata - Restricted to *Pinus*, causing a white root and butt rot of living trees and also continuing decay and fruiting on dead trees and stumps. Known from *Pinus taeda* L. (loblolly pine) and *Pinus glabra* Walt. (spruce pine).

Distribution - Apparently through the Gulf Coast region from east Texas to Georgia.

Specimens examined: JEA 395, R. Summers, on *Pinus taeda* L. (loblolly pine), USFS Stuart seed orchard, Pineville, Grant Parish, LA, Aug. 21, 1985 (Holotype); JEA 393, 394,397,399, same data; JEA 305, G.F. Joge, on *P. taeda* stump, Baton Rouge, East Baton Rouge Parish, LA, Nov. 20,1984; CMD 3, on *P. taeda* stump, Oct. 11, 1984; MB 2110, at base of living *P. glabra* Walt. (spruce pine), LSU campus, Baton Rouge, Oct. 26, 1984; MB 2249, on living *P. glabra*, LSU campus, Baton Rouge, July 10, 1985; MB 2086, on *P. taeda* stump, Baton Rouge, Sept. 21, 1984; JEA 345, C.M. Dugas, on *P. taeda* stump, Baton Rouge, July 17, 1985; E.W. Ross 279, on *Pinus* sp. stump, Athens, Clarke County, GA, July 27, 1969.

Cultural characteristics

Macroscopic: Growth moderate, malt extract agar (MEA) plates covered in 3-4 weeks; advancing zone bayed, aerial mycelium extending to limit of growth; mat white and remaining so for 3-4 weeks, with dense radiating and branching strands that give it a distinctly feathery or plumose appearance, eventually becoming Primuline Yellow-Xanthine Orange to Ochracheous Tawny, crustose and appressed, often becoming grooved or wrinkled; mycelium forming radiating, white, sinuous strands or cordons; reverse bleached and eventually darkening, becoming Burnt Sienna-Mahagony Red to Xanthine Orange under the mat; odor faintly fruity; on gallic acid medium reaction moderately strong to weak, growth 10-20 mm in 4 wk; on tannic acid medium reaction strong to moderately strong, growth 13-25 mm in 4 weeks; optimum temperature range 25-30 C on MEA, growth rate 3-5 mm/day; no growth above 35 C.

Microscopic: Hyphae of advancing zone hyaline, clamped, 2-5 (-7) µm in diam with thin walled, intercalary vesicles forming at irregular distances along hyphae; aerial mycelium with (1) some hyphae as in advancing zone; (2) fiber hyphae that are thick-walled, rarely branched, 1-2 µm in diam; (3) cuticular cells that are thin- to thick-walled, globose to irregular in shape, produced singly or in chains from swollen hyphae, variable in size, 15-23 (-25) X 6-14 µm, empty or filled with cytoplasm, thick-walled type strongly amyloid; (4) thick-walled, amyloid, moniliform hyphae in older cultures; (5) staghorn hyphae sporadically produced, not as abundant as those in cultures of *G. lucidum* and *G. tsugae*, apparently lacking in some cultures; hyphae of submerged mycelium as in advancing zone, crystals abundant to few; chlamydospores not produced.

Cultures examined: JEA 393,395,399; MB 2249.

Species code: 2,3,8,10,16,26,32,36,39,40,43,44,55 (Nobles, 1965).

Remarks: The cultural characteristics of *G. meredithae* do not fit those of any of the *Ganoderma* species described in detail by Nobles (1948).

DISCUSSION

Ganoderma collections from pine in the past have been referred to as *Ganoderma lucidum*, *G. curtisii* (Berk.) Murr. or *G. tsugae*. Our concept of *G. lucidum* is that it occurs only on hardwoods. It is consistently characterized in North America by production of distinctive chlamydospores in culture and an optimum temperature range of 30-35 C with some growth up to 42 C. *Ganoderma tsugae* occurs mainly on conifers and occasionally on birch in northern latitudes. It has an optimum growth temperature of 20-25 C and does not grow above 30 C. *Ganoderma tsugae* is a common species in the northeastern and northcentral United States and eastern Canada on *Tsuga* and in southwestern United States on *Abies*. These main hosts are associated with species of pine. However, *Ganoderma tsugae* has rarely been reported on pine in these regions. *Ganoderma meredithae* has an optimum growth temperature of 25-30 C, with growth up to 35 C, and produces plumose or feathery mats. Furthermore, *G. tsugae* and *G. meredithae* differ in morphology of pilocystidia and basidiospores (Adaskaveg and Gilbertson, 1988). It is not reasonable to consider the southern pine *Ganoderma* to be *G. tsugae*. *Ganoderma curtisii* has been recognized as distinct from *G. lucidum* by Overholts (1953) and others on the basis of having stipitate basidiocarps. However, it is established that *G. lucidum* and *G. meredithae* basidiocarps vary from stipitate to sessile and, at least with *G. lucidum*, cultures from sessile basidiocarps will produce stipitate ones (Adaskaveg and Gilbertson, 1986c). The neotype of *G. curtisii* at Kew has a part of the substratum adhering to it and we have identified this as hardwood bark, probably of oak. It is certainly not pine bark. Resinous zones considered by Steyaert (1980) to be an important character of *G. curtisii* are typical of *G. meredithae* but also occur in *G. lucidum*. The macro- and microscopic morphological characters of the neotype of *G. curtisii* fit our concept of *G. lucidum* and there is no reason to consider *G. curtisii* as anything other than a synonym of *G. lucidum* (Adaskaveg and Gilbertson, 1986c). Steyaert (1980) described *G. ravenelii* as a new species based on a portion of the former neotype of *G. curtisii*, considering that portion to have different spore and context morphology than the rest of the *G. curtisii* neotype. Our examination of the specimen designated as the holotype of *G. ravenelii* by Steyaert indicates that it does have spores that are more narrow than those of the *G. curtisii* neotype. Basidiospores of the *G. ravenelii* holotype are different from those of *G. meredithae* and are more like those of *G. zonatum*, a species found on palms from the southeastern United States (Adaskaveg and Gilbertson, 1986b). However, there is no information on the substratum of the *G. ravenelii* holotype. There is no reason to believe it was on pine and no reason to apply the name *G. ravenelii* to the pine *Ganoderma*. When all of the evidence from basidiocarp morphology, cultural characteristics, temperature relationships, substratum relationships, and geographical distribution are considered the only defensible and logical alternative is to consider the pine *Ganoderma* to be a species distinct from the other members of the *G. lucidum* complex in North America (Adaskaveg and Gilbertson, 1986a,b,c, 1988). Some species of *Ganoderma* on conifers (i.e., *G. carnosum* Pat., *G. atkinsonii* Jahn, Kotl. and Pouzar) from Europe and other regions unfortunately have not been characterized as to cultural morphology and it is not possible to draw any conclusions on the application of any of these names to North American *Ganoderma* species. Stalpers (1978) considers *G. valesiacum* Bourd. of Europe a synonym of *G. tsugae*.

The distinguishing characteristics of *G. meredithae* are the restriction to pines, the frequently lobed or branched pilocystidia, the plumose or feathery mats produced in culture, the lack of chlamydospores, and the optimum growth temperatures of 25-30 C, intermediate between *G. lucidum* and *G. tsugae*. Its temperature relationships are similar to those of *G. zonatum* (Adaskaveg and Gilbertson, 1986a). However, *G. zonatum* differs in several respects including host specificity (on palms), distinctive, narrow basidiospores, and different cultural morphology.

ACKNOWLEDGMENTS

The authors would like to thank Dr. M. Blackwell for her collections and her enthusiastic interest in our studies of *Ganoderma* species; also R. Summers, G.F. Joge, C.M. Dugas, and E.W. Ross for their collections of *G. meredithae*.

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MYCOTAXON

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NOTICE:

IMC IV REGENSBURG 1990, PRELIMINARY ANNOUNCEMENT

Preliminary plans for the Fourth International Mycological Congress, to be held at the University of Regensburg, in West Germany, from 28 August to 3 September, 1990, have been announced.

The date also allows for an appropriate 200th anniversary commemoration of the death of Jakob Christian Schäffer, famous mycologist and citizen of Regensburg.

Participants will be housed in hotels in Regensburg. The city center is within walking distance of the university campus. Both pre-congress and post-congress forays, excursions, and sightseeing tours will be offered.

Further information may be obtained from:

Prof. Dr. A. Bresinsky
Institut für Botanik
Universität Regensburg
Universitätsstraße 31
Postfach 397
D-8400 Regensburg
West Germany

[Telephone: (0941) 9431 3108]

NOTICES:

BELTSVILLE SYMPOSIUM XIII BIOTIC DIVERSITY AND GERMPLASM PRESERVATION : GLOBAL IMPERATIVES

A first announcement of this symposium to be held May 9-11, 1988 at Beltsville Maryland has been mailed. The program will include 26 invited papers, invited and contributed posters, and demonstrations of computer applications. To receive the second announcement address:

Mrs. J. Weirman
Room 127, Building 001
Beltsville Agricultural Research Center–West
Beltsville, MD 20705

* * *

ASPERGILLUS AND PENICILLIUM IDENTIFICATION WORKSHOP, 1988

A first circular on this workshop, organized by the Mycological Society of Japan, has been distributed. It is primarily a laboratory course, and will be held in the Sugadira Montane Research Center, University of Tsukuba, Sanada, Nagano Prefecture, Japan, from August 28–September 3, 1988, following the 5th International Congress of Plant Pathology to be held in Kyoto, August 20-28.

Participants will hear lectures and will examine and learn to identify some 100 common species of *Aspergillus, Penicillium,* and related teleomorphs.

Interested persons should immediately contact:

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Bunkyo-ku, Tokyo 113
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STUDIES ON SOME DISCOMYCETE GENERA WITH AN IONOMIDOTIC REACTION: IONOMIDOTIS, POLONIODISCUS, CORDIERITES, PHYLLOMYCES, AND AMEGHINIELLA

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AC AY 2 '88

ABSTRACT

The genera *Ionomidotis*, *Poloniodiscus*, *Cordierites*, *Phyllomyces*, and *Ameghiniella* have been reviewed. Based on type studies, *Ionomidotis*, *Cordierites*, and *Ameghiniella* are accepted as the correct names for three genera of the Leotiaceae, Encoelioideae. The distinctions among them are discussed, and keys to the species are provided. The ionomidotic reaction occurs in some species, only, and also occurs in species referred here to *Encoelia*, and is thus not suitable for use as a generic character in this case. *Cordierites boedijnii* is described as a new species; *Ameghiniella plicata, Chlorencoelia indica, Encoelia fuscobrunnea, Encoelia nicaraguensis, Encoelia urceolata,* and *Ionomidotis australis* are recorded as new combinations.

INTRODUCTION

The genus *Cordierites* Mont. has been taken in a very broad sense (Korf, 1973; Rifai, 1977). This paper addresses detailed work on *Cordierites* and on several genera related to it, i.e., *Phyllomyces* Lloyd, *Ionomidotis* Durand, *Poloniodiscus* Svrček & Kubička, and *Ameghiniella* Spegazzini.

During my studies at Cornell University, I have had a chance to examine *Cordierites guianensis* Mont. sensu Boedijn from Java in the herbarium of Richard P. Korf, fresh collections of *Ionomidotis olivascens* Durand from Jamaica and *I. irregularis* from the Ithaca area, and some *Ionomidotis* species in the Durand herbarium in the Plant Pathology Herbarium, Cornell University. My examination of these materials revealed significant differences in apothecial anatomy, which enhanced my attempt to clarify the taxonomic problems of this group of fungi. Although type specimens and many additional collections have been studied, this paper does not cover all known material in the world. Traditional methods were used in anatomical studies. An apothecium or a portion of an apothecium was sectioned on a freezing microtome at 15 μm, and the sections were mounted either in cotton blue lactic acid or in Melzer's reagent. The ionomidotic reaction was observed by soaking a small fragment of apothecial tissue in 2% or 10% aqueous KOH solution. The photographs were taken under a Zeiss microscope equipped with a camera. The abbreviations of literature citations are based on *Botanico – Periodicum – Huntianum* (Lawrence, et al., 1968), and those of names of herbaria based on *Index Herbariorum* (Holmgren, et al., 1981).

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HISTORICAL REVIEW AND TAXONOMY OF THE GENERA

1. Historical Review

Cordierites Mont. was established to accommodate a single species, *C. guianensis,* which was originally assigned to the Pyrenomycetes (Montagne, 1840). It remained monotypic for more than a decade. Several species have then been added to the genus (Berkeley, 1856, 1867; Cooke, 1875; Möller, 1901; Korf, 1971; Sharma &Thind, 1983; Samuels & Kohn, 1987). Saccardo (1883) correctly removed this genus from the Pyrenomycetes, and later placed it in the family Cordieriteae of the Discomycetes (Saccardo, 1884, 1889). Ciferri (1957) indicated that the genus should belong to the family Helotiaceae. Dennis (1978) placed *Cordierites* in the Encoelioideae of the Helotiaceae; and Korf (1973) and Rifai (1977) treated it in the Encoelioideae of the Leotiaceae, which is accepted in this paper.

Durand (1923) published a paper entitled "The genera *Midotis*, *Ionomidotis* and *Cordierites*" in which he described his genus *Ionomidotis.* Although he did not directly mention his generic concept of *Cordierites* in that paper, he removed *C. irregularis* and *C. sprucei* to *Ionomidotis.* The former is the lectotype species of *Ionomidotis* (Korf, 1958), and the latter is a good species of *Cordierites* according to the results of my study.

In 1936, Boedijn published a paper on the genus *Cordierites* based on two collections from Java. He presented a very detailed description and illustration of these materials, concluded that the genus was monotypic, and listed *C. sprucei*, *C. muscoides*, *C. coralloides*, *C. fasciculata*, and *C. umbilicarioides* as synonyms of the type species of that genus, *C. guianensis.* I disagree with his synonymy, and think that the Javanese collections represent a different taxon in the same genus, and that three species are involved.

In 1957, Ciferri reviewed the species of *Cordierites*. He concluded that the genus contained only a single species, Montagne's *C. guianensis*, and pointed out that Boedijn's concept of this species is quite different from Montagne's original one. He treated Boedijn's "*C. guianensis*" as *Midotis boedijnii*. I agree with him that Boedijn's fungus is not conspecific with *C. guianensis*, but disagree with his placement of that fungus in *Midotis*. Even though he examined the type and specimens of a few other species of *Cordierites* and provided useful, though occasionally incorrect, literature citations for these taxa, I have difficulty comprehending many of his observations, interpretations and taxonomic opinions. I shall take up specific points in the discussion of each taxon.

Ameghiniella Speg. was coined for a single species, *A. australis* Spegazzini (1888). Though his generic and specific descriptions were relatively detailed, the genus is unknown to most mycologists, and has remained monotypic. Clements and Shear (1931) mistakenly synonymized this genus with *Cenangium*. Nannfeldt (1932) in his discussion of the Dermateaceae noted that the genus was known to him only from the description, belonged to the inoperculate Discomycetes, and that he had no position for it. When Gamundí examined the type species of *Ionomidotis chilensis*, she annotated it as "*Ionomidotis chilensis* Durand (1923) = *Ameghiniella australis* Speg., Bol. Ac. Nac. Cs. Cordoba 11: 270. 1887."

The type specimen of *A. australis* was kindly sent to me by Dr. Gamundí. My observation has shown that *A. australis* and *I. chilensis* are not synonyms. *Ameghiniella* and *Ionomidotis* are obviously closely related fungi in the Encoelioideae, but are not congeneric. Although species of both genera exude violet pigmentation in aqueous KOH solution (ionomidotic reaction), they have a different anatomical structure. I distinguish them at the generic level.

Phyllomyces Lloyd (1921) was erected for a single species, *P. multiplex*, which is on dead wood, with ear-shaped and lobed apothecia arising from branched or complex stipes. The genus has remained monotypic. After his examination of the type specimen of this genus, Korf (1973) indicated in his key to the genera of Discomycetes and Tuberales that *Phyllomyces* is a synonym of *Cordierites*. My observations fully agree with his synonymy, and prove that *C. sprucei* Berkeley (1856) is an earlier name for *P. multiplex*.

Ionomidotis Durand (1923) was established to accommodate seven species which exude violet pigmentation from the apothecial tissues when treated with aqueous KOH solution. Durand provided a relatively extensive generic description, but failed to designate the type for the genus. In the following years, the genus was accepted by many mycologists, and quite a few species were added (Seaver, 1925; Cash, 1939; Korf, 1958; Le Gal, 1959; Dennis, 1970). Korf (1958) lectotypified the genus with *I. irregularis*

(Schw.) Durand. The genus was placed in the Helotieae of the Helotiaceae by Seaver (1951), the Dermateaceae by Korf (1958), the Encoelioideae of the Helotiaceae by Le Gal (1959) and by Dennis (1978), and the Encoelioideae of the Leotiaceae by Korf (1973). I accept the placement of this genus in the Encoelioideae of the Leotiaceae.

Seaver (1951) synonymized *Ionomidotis* with *Midotis*, a doubtful generic name, the type species of which remains unknown. *Midotis* has been applied in various senses. Four of Durand's original species of *Ionomidotis* were transferred to *Midotis* by Seaver. In his paper on *Cordierites*, Ciferri (1957) accepted Seaver's opinion, and transferred a fifth Durand species, *I. chilensis*, to *Midotis*. Korf (1973) listed this genus as a synonym of *Cordierites*, which was later accepted by Rifai (1977) and by Dennis (1978). I think that two distinct genera are involved on the basis of anatomical structure, and accept both *Cordierites* and *Ionomidotis*.

Poloniodiscus Svrček & Kubička (1967) was published for a single species, *P. fischeri*, which was later discovered to be a synonym of *Ionomidotis irregularis* (Korf, 1973; Dennis, 1978), and the genus has remained monotypic. *Poloniodiscus* becomes a later synonym of *Ionomidotis*. My observations have confirmed the treatments by Korf and by Dennis.

2. The Ionomidotic Reaction and Taxonomy of the Genera

Before the genus *Ionomidotis* was established (Durand, 1923), the exudation of violet pigmentation in aqueous KOH solutions from the apothecial tissues of certain discomycetes had seldom been used in classification, and perhaps not been paid enough attention to by many mycologists. In later years, this character became diagnostic. Korf (1958) named this phenomenon the ionomidotic reaction. Cash (1939), Korf (1958), Le Gal (1959), and Dennis (1970) transferred a few fungi to *Ionomidotis* based on this and other features. I agree with them that the ionomidotic reaction is a useful tool in taxonomy. On the contrary, Seaver (1951) and Ciferri (1957) ignored this character.

Two of the seven original species of *Ionomidotis* were transferred from *Cordierites* (Durand, 1923), which suggests some connection between these two genera. Stipes branching or arising from a common base, apothecia more or less unequal-sided, and the outer ectal excipulum encoelioid (at maturity the outer cells of the excipulum becoming loose and often the receptacle surface appearing mealy) prove that they are a group of closely related discomycetes. Korf (1973) pointed out that *Ionomidotis*, *Phyllomyces* and *Poloniodiscus* are synonyms of *Cordierites*. This concept has been accepted by Rifai (1977), Dennis (1978), and Sharma & Thind (1983).

My type studies of the species of *Cordierites*, *Phyllomyces*, *Ionomidotis*, *Poloniodiscus*, and *Ameghiniella* have shown that three different anatomical arrangements can be recognized among the five genera. In *Cordierites* and *Phyllomyces*, cells of the ectal excipulum and hyphae of the medullary excipulum are not immersed in a gelatinous matrix, the subhymenium is often distinguishable, asci are subcylindrical, ascospores are uniformly ellipsoid and uniseriate in an ascus. In members of *Ionomidotis* and *Poloniodiscus* cells of the ectal excipulum and hyphae of the medullary excipulum are immersed in a gel matrix and so is the hymenium, the subhymenium is very thin or indistinguishable, the asci are clavate, and the ascospores are allantoid to ellipsoid and biseriate to irregularly biseriate in an ascus. *Ameghiniella* shares with *Ionomidotis* strongly ionomidotic tissues, gregarous apothecia arising from a common base, clavate asci, and allantoid ascospores. But unlike *Ionomidotis*, *Ameghiniella* is characterized by deeply cupulate apothecia when dry, an ectal excipulum of well-developed textura angularis composed of isodiametric, pigmented cells not immersed in gel, a medullary excipulum also lacking gel, and multiguttulate ascospores. I treat the above differences at generic level, and recognize three genera, *Ionomidotis*, *Cordierites*, and *Ameghiniella*. Korf and Dumont (1968) pointed out that the sterile tissues of the apothecium provided valuable taxonomic information. I fully agree with them. In taxonomy of these genera, I put more emphasis on the anatomical structure of apothecia of each species than on the measurements of asci and of ascospores. In regard to the ionomidotic reaction, two species of *Cordierites* react faintly, and one is strongly ionomidotic; all species in *Ionomidotis* and *Ameghiniella* are strongly ionomidotic.

In this paper, I have transferred three species, two weakly ionomidotic and one strongly exuding yellowish brown pigmentation in KOH solution (? xanthochroic), from *Ionomidotis* to the genus *Encoelia* because of their isodiametric, loosely interconnected and pigmented ectal excipular cells, and pustulate receptacle surface. The generic concept of *Encoelia* is taken here in a broad sense.

Most known species of *Ionomidotis*, *Cordierites* and *Ameghiniella* are found in tropical or subtropical areas. *I. australis*, *I. fulvotingens* and *I. irregularis* are distributed in temperate regions. Fungi of these genera usually occur on wood; *I. frondosa*, *I. fulvotingens*, *I. olivascens*, and *C. guianensis* may be associated with other fungi. Studies of these genera in pure culture have not been reported.

3. Key to the Accepted Genera

1. Apothecium discoid to infundibuliform, stipitate, stipes branched or arising from a common base, apothecial tissues not gelatinized at all, ionomidotic or non-ionomidotic, asci subcylindrical, ascospores ellipsoid .... *Cordierites*

1'. Apothecium lobed to ear-shaped, or deeply cupulate, sessile to substipitate, often several arising from a common base, apothecial tissues immersed in gel or slightly gelatinized, strongly ionomidotic, asci clavate, ascospores allantoid, rod-shaped to ellipsoid 2
  2. Apothecium discoid to ear-shaped, ectal excipulum of textura intricata, textura prismatica to textura angularis, cells thin-walled, tissues immersed in gel, or at least ectal excipular cells sheathed by a gel layer .... *Ionomidotis*
  2'. Apothecium deeply cupulate, receptacle strongly pustulate, ectal excipulum of textura angularis, cells thick-walled, tissues not immersed in gel .... *Ameghiniella*

THE GENUS *IONOMIDOTIS*

1. Generic Description

IONOMIDOTIS Durand, Proc. Amer. Acad. Arts 59: 8, 1923.
= *Poloniodiscus* Svrček & Kubička, Česká Mykol. 21: 153, 1967.

Apothecia small to large, very dark when dry, discoid, flat, or ear-shaped, gregarious, sometimes solitary, sessile to short-stipitate, stipes often arising from a common base; margin smooth, undulate, or lobed; receptacle surface smooth, roughened, wrinkled, or pustulate; tissues strongly ionomidotic. Ectal excipulum of loosely arranged textura angularis or textura prismatica to textura intricata, cells elongated, rectangular to more or less hyphoid, loosely interconnected, immersed in gel or at least sheathed by a thin layer of gel, axes of cells nearly perpendicular to the outer surface, walls subhyaline, cells forming pustules sometimes not immersed in gel and with pigmented walls. Medullary excipulum of textura intricata usually immersed in gel, hyphal walls subhyaline. Subhymenium thin or indistinguishable. Asci inoperculate, 8-spored, clavate, J–, pore walls not turning blue in Melzer's reagent with or without KOH pretreatment, sometimes immersed in gel. Ascospores biseriate to irregularly uniseriate, allantoid or rod-shaped to ellipsoid, subhyaline to yellowish, smooth-walled, unicellular, with 2-4 guttules. Paraphyses filiform, straight or curved at apex, in one species with fusoid apices which may become detached, equal to or slightly exceeding asci.

On wood, some species associated with other fungi.

Lectotype: *Ionomidotis irregularis* (Schw.) Durand, selected by Korf (1958).

2. Key to the Accepted Species

1. Apothecium discoid at maturity 2

1'. Apothecium discoid with one side elongated, or ear-shaped at maturity 4
  2. Apothecium turbinate, hyphae immersed in a great amount of gel, ectal excipulum of textura intricata, paraphysis apices with a fan-shaped gelatinous cap .... *I. australis*
  2'. Apothecium discoid, hyphae immersed in gel not as abundant, paraphysis apices without a gelatinous cap 3
3. Apothecium 2-5 mm in diam, ectal excipulum of textura prismatica, axes of cells perpendicular to the outer surface, medullary excipulum thin, outer ectal excipular cells totally immersed in gel .... *I. fulvotingens*
3'. Apothecium 5-8 mm in diam, ectal excipulum of textura angularis mixed with textura intricata, medullary excipulum thick, outer ectal excipular cells loosely arranged, sheathed by a thin layer of gel ... *I. portoricensis*
  4. Paraphyses with an acute, lanceolate head .... *I. irregularis*
  4'. Paraphyses filiform without a lanceolate head 5
5. Ectal excipulum of textura intricata, associated with *Hypoxylon* sp., ascospores 1.5-2.2 µm wide .... *I. olivascens*
5'. Ectal excipulum of textura angularis mixed with textura prismatica or with textura intricata, ascospores often less than 1.5 µm wide 6
  6. Ectal excipulum of textura prismatica to textura angularis, outer cells covered by a thin layer of gel, subhymenium very thin, 0-10 µm thick .... *I. chilensis*
  6'. Ectal excipulum of textura angularis to textura intricata, outer cells immersed in gel, subhymenium well-developed, 30 µm thick .... *I. frondosa*

3. Accepted Species

Ionomidotis australis (Beaton in Beaton & Weste) Zhuang, **comb. nov.** (Figs. 1, 2, 28)

≡ *Claussenomyces australis* Beaton in Beaton & Weste, Trans. Brit. Mycol. Soc. 71: 215, 1978.

Apothecium flat to turbinate when dry, convex, flat or distorted when fresh, sessile, broadly attached to the substrate, 5-7 mm in diam when dry (up to 25 mm in diam when fresh according to the original author), gregarious or solitary; strongly ionomidotic, purple pigmentation exuding from tissues in 2% aqueous KOH solution; hymenium black when dry, ivy green when fresh; receptacle black, surface smooth when fresh, wrinkled and roughened when dry. Ectal excipulum of textura intricata, immersed in a gel matrix, 30-50 µm thick; cells elongated to hyphoid, axes of cells nearly perpendicular to the outer surface, cell walls subhyaline; receptacle slightly pustulate. Medullary excipulum of textura intricata, tissues immersed in a large amount of gel; hyphae loosely interwoven, hyphal walls subhyaline. Subhymenium not clearly distinguishable. Asci 8-spored, clavate, J– in

Melzer's reagent, 29.5-37.5 x 4.2-4.6(-5) µm, immersed in a gel matrix. Ascospores allantoid to rod-shaped, biseriate to irregularly biseriate, biguttulate, 5.0-7.3 x 1.3-1.5 µm (5-7 x 1.5-2.5 according to Beaton). Paraphyses filiform, sometimes branched, ca. 1 µm wide, up to 1.5 µm wide at apex, with a fan-shaped gel cap on the top seen clearly when mounted in Melzer's reagent, equal to or slightly exceeding asci.

On bark of a dead, unidentified eucalypt branch.

Illustrations: Beaton, G. & G. Weste, Trans. Brit. Mycol. Soc. 71: 215, fig. 1, 1978 (as *Claussenomyces australis*). This paper figs. 1, 2, 28.

Specimens examined: AUSTRALIA: on bark of a dead, unidentified eucalypt branch, Kennedy's Ck. Rd., about 3 km from Laver's Hill, Victoria, G. Beaton 53, 6. I. 1962, MELU (holotype), G. Beaton Pers. Herb. (isotype) (filed under *Claussenomyces australis*).

Notes: This species is characterized by a turbinate apothecium, very thick, highly gelatinous medullary excipular tissue, and gel-capped paraphysis apices. That the original author treated this fungus as a species of *Claussenomyces* is probably because of the large amount of gel in the excipular tissues, but all other characters are typical of *Ionomidotis*, especially the small, allantoid ascospores which never produce ascoconidia within the ascus.

IONOMIDOTIS CHILENSIS Durand, Proc. Amer. Acad. Arts 59: 11, 1923. (Figs. 3, 4, 29)

≡ *Midotis chilensis* (Durand) Cifer., Ist. Bot. Real Univ. Reale Lab. Crittog. Pavia Atti Ser. 5, 14: 269, 1957.

Apothecium ear-shaped, lobed, or discoid with one side elongated, up to 25 mm in length and 30 mm wide, gregarious to solitary, short-stipitate, stipes arising from a common base; tissues strongly ionomidotic in KOH, purple pigmentation exuding from tissues in 2% aqueous KOH solution; hymenium black; receptacle brownish black, surface wrinkled to slightly granulate when dry. Ectal excipulum of textura prismatica to textura angularis, ca. 35 µm thick; cells club-shaped, rectangular, ellipsoid, or ovoid, axes of cells nearly perpendicular to the outer surface, cells in the outermost layer loosely interconnected, cell walls subhyaline to pale yellow, covered by a thin layer of gel; receptacle not pustulate near margin, sometimes slightly pustulate at flanks. Medullary excipulum of textura intricata, mostly immersed in gel except adjacent to the ectal excipulum; hyphae loosely interwoven, walls subhyaline. Subhymenium of textura intricata, 0-10 µm thick. Asci 8-spored, clavate, J– in Melzer's reagent, 33-40 x 3.7-3.9 µm (40-45 µm long according to Durand), arising from croziers. Ascospores allantoid, biseriate, to irregularly biseriate, with 2-4 or rarely more small guttules, 4.7-6.5 x 1.3-1.5 µm. Paraphyses filiform, straight or slightly curved at apex, slightly swollen and branched at apex, 1.0-1.5 µm wide, exceeding asci up to 10 µm.

On rotting log.

Illustrations: Durand, E. J., Proc. Amer. Acad. Arts 59: pl. 1, pl. 2, fig. 7, 1923. Ciferri, R. Ist. Bot. Real Univ. Reale Lab. Crittog. Pavia Atti, Ser. 5, 14: pl., 1, figs. 4, 5, 1957 (as *Midotis chilensis*). This paper figs. 3, 4, 29.

Specimens examined: CHILE: on rotting wood, Corral, R. Thaxter, XII, 1905, FH (holotype); CUP-D 10762 (15-3), NY (isotypes).

Notes: This is one of the original species of *Ionomidotis* Durand. The shape of the ectal excipular cells of this species is somewhat similar to that of *I. portoricensis* Seaver (1925), but the former has larger apothecia (25 x 30 mm *vs*. 5-8 mm in diam or in width) which are ear-shaped instead of discoid to cupulate, with more loosely interconnected cells in outer ectal excipulum and at margin, and with curved paraphyses instead of straight.

On the hymenium surface, many short, branched, irregularly catenulate cells were found. They are either produced by germinated ascospores, or are the reproductive structures of another fungus.

Without examining the type, Ciferri (1957) erroneously determined that *I. chilensis* (as *Midotis chilensis*) is a young specimen of *I. irregularis* (as *Midotis irregularis* Cke.). Actually, *I. chilensis* has never produces ellipsoid ascospores or lanceolate paraphysis tips even when it is fully mature.

IONOMIDOTIS FRONDOSA (Kobayasi) Kobayasi & Korf in Korf, Sci. Rep. Yokohama Natl. Univ., Ser. 2, 7: 19, 1958. (Figs. 5, 6, 30)

≡ *Bulgaria frondosa* Kobayasi, Bot. Mag. (Tokyo) 53: 158, 1939.

≡ *Cordierites frondosa* (Kobayasi) Korf, Phytologia 21: 203, 1971.

Apothecium discoid with one side elongated, or ear-shaped, lobed, 5-8 mm in diam when dry (10-40 mm according to Kobayasi), gregarious, sessile to short-stipitate, stipes arising from a common base; tissues strongly ionomidotic in KOH solution; hymenium black to nearly black; receptacle concolorous, surface minutely pustulate when dry. Ectal excipulum of textura angularis to textura intricata, ca. 30 µm thick, immersed in gel; hyphae more or less parallel, axes of hyphae perpendicular to the outer surface, cell walls subhyaline; receptacle pustulate, cells in pustules angular, ellipsoid, also immersed in gel, walls pale brown, contents brown. Medullary excipulum of textura intricata, immersed in gel; hyphae 2.5-3.0 µm wide, hyphal walls subhyaline, contents pale brown. Subhymenium of textura intricata, ca. 30 µm thick; hyphae densely interwoven. Asci 8-spored, clavate, J– in Melzer's reagent, (31-)34-40 x 3.5-4.5 µm. Ascospores rod-shaped to allantoid, irregularly biseriate, with 2 to several guttules, 4.0-4.5(-5.6) x 1.0-1.4 µm. Paraphyses filiform, curved to slightly circinate and slightly swollen at apex, septate, 1.2-1.4 µm wide, exceeding asci 3-7 µm.

On decorticated wood associated with a ?*Coniochaeta* sp.

Illustrations: Kobayasi, Y., Bot. Mag. (Tokyo) 53: 158-159, figs. 1, 2, 1939 (as *Bulgaria frondosa*). This paper figs. 5, 6, 30.

Specimens examined: JAPAN: on decorticated wood [associated with a ?*Coniochaeta* sp.], Shiratori Mt., near Iinomachi, Kirishima National Park, Miyazaki Pref., Kyushu, S. Imai, et al., 3. XI. 1957, CUP-JA 387, R. P. Korf Pers. Herb.-JA 387; Miharayama Mountain Tokyo, Oshima Island, (no collector), 6. VI. 1956, CUP-JA 1558, R. P. Korf Pers. Herb.-JA 1558.

Notes: The type specimen of this species is lost. But when Kobayasi and Korf transferred this fungus from *Bulgaria* to *Ionomidotis*, JA 387 was confirmed by the original author, and is authentic (Korf, 1958). This fungus can be distinguished from *I. olivascens* by the more or less pustulate receptacle surface, shorter asci, smaller ascospores, and the curved to slightly circinate paraphysis apices. This species is associated with a pyrenomycete, possibly *Coniochaeta* sp.

I designate CUP-JA 387 as the NEOTYPE of this species.

IONOMIDOTIS FULVOTINGENS (Berk. & Curt.) Cash, J. Wash. Acad. Sci. 29: 50, 1939. (Figs. 7, 8, 31)

≡ *Cenangium fulvo-tingens* Berk. & Curt., Grevillea 4: 4, 1875.

Apothecium discoid, margin somewhat folded inward, 1.5-2.3 mm in diam when dry (2-5 mm in diam when fresh according to Luthi, 1969), gregarious or solitary, sessile to very shortly stipitate; tissues ionomidotic in KOH solution; hymenium black; receptacle concolorous, surface wrinkled when dry. Ectal excipulum of textura primatica, 25-34 µm thick, immersed in a gelatinous matrix; cells elongated to rectangular, axes of cells perpendicular to the outer surface, cell walls subhyaline. Medullary excipulum of textura intricata, tissues immersed in gel, 11-44 µm thick; hyphae somewhat parallel to the outer surface, hyphal walls subhyaline. Subhymenium not well-developed, of textura intricata, 0-5 µm thick. Asci 8-spored, clavate, J– in Melzer's reagent, ca. 45-48 x 3.7-4.0 µm (40 x 5 µm according to Luthi), immersed in gel. Ascospores allantoid to rod-shaped, irregularly biseriate, biguttulate, 5.1-6.0 x 1.4-1.5 µm (5-8 x 1.5-2 µm according to Luthi, 1969). Paraphyses filiform, straight, immersed in a gel matrix, 1.0-1.8 µm wide, exceeding asci 4-7 µm.

On wood associated with other fungi.

Illustrations: Luthi, R., Schweiz. Zeit. Pilzk. Bull. Suisse Mycol. 47: 121, figs. a-f, 1969. This paper figs. 7, 8, 31.

Specimens examined: UNITED STATES: on wood [associated with other fungi], Penn., Michener 2537, (no date), CUP-D 3598 (33-243) (ex 5172, isotype), FH-Curtis Herb. 5172 (isotype) (filed under *Cenangium fulvo-tingens*).

Notes: This species has smallest apothecia in the genus, which are discoid, folded inward when dry. The ectal excipulum is immersed in a gel which stains in cotton blue, and the axes of the elongate ectal excipular cells are perpendicular to the outer surface. The arrangement of the medullary hyphae is somewhat parallel to the outer surface, which is unusual in this genus. The substrate which has been indicated as decorticated wood is covered by other fungi. The species might be fungicolous. Cash (1939) has made some comments on the ionomidotic reaction of this fungus and of some other species of *Ionomidotis*. Luthi (1969) provided very good illustrations of both gross morphology and anatomy of this fungus.

IONOMIDOTIS IRREGULARIS (Schw.) Durand, Proc. Amer. Acad. Arts 59: 9, 1923. (Figs. 9, 10, 32)
≡ *Peziza irregularis* Schw., Trans. Amer. Philos. Soc. 4: 171, 1832.
≡ *Cordierites irregularis* (Schw.) Cooke, Bull. Buffalo Soc. Nat. Sci. 3: 26, 1875.
≡ *Midotis irregularis* (Schw.) Cooke in Sacc., Syll. Fung. 11: 42, 1895.
= *Peziza doratophora* Ellis & Ev., J. Mycol. 1: 90, 1885.
≡ *Otidea doratophora* (Ellis & Ev.) Sacc., Syll. Fung. 8: 96, 1889.
= *Poloniodiscus fischeri* Svrček & Kubička, Česká Mykol. 21: 154, 1967.

Apothecium ear- to fan-shaped, irregularly lobed, much elongated on one side, 18-35(-50) x 11-28(-40) mm in size (the clusters 5-7 cm wide according to Durand), gregarious to solitary, short-stipitate, stipes arising from a common base; tissues strongly ionomidotic in KOH; hymenium dark purple to nearly black, receptacle dark purplish brown, surface pustulate, sometimes covered with a buff powder. Ectal excipulum of textura angularis to textura prismatica, immersed in a gel matrix; cells mostly elongated to rectangular, axes of cells nearly perpendicular to the outer surface, cell walls subhyaline, cytoplasm with purplish contents; receptacle pustulate, cells in pustules spherical to subspherical, 7-15 µm in diam, walls thin, pigmented, not immersed in gel. Medullary excipulum of textura intricata, tissues immersed in gel; hyphae densely interwoven, hyphal walls subhyaline, cytoplasm with purplish contents. Subhymenium not clearly distinguishable. Asci 8-spored, clavate, J– in Melzer's reagent, ca. 60-70 x 5.7-6.5 µm (50-70 x 4-5 according to Durand). Ascospores ellipsoid, irregularly uniseriate, biguttulate, 8-10 x 3.4-3.6 µm (3-4 µm wide according to Durand). Paraphyses filiform, with an abrupt, lanceolate, acute apex, 1.5 µm wide below and 2.2-3.7 µm wide at the widest part of the lanceolate apex, septate, exceeding asci 7-11 µm, the apex sometimes becoming detached.

On wood.

Illustrations: Durand, E. J., Proc. Amer. Acad. Arts 59: pl. 1, pl. 2, figs. 5, 6, 1923. Ciferri, R., Ist. Bot. Real Univ. Reale Lab. Crittog. Pavia Atti Ser. 5, 14: pl., 1, figs. 1, 2, 1957 (as *Midotis irregularis*). Svrček, M. & J. Kubička, Česká Mykol. 21: 152, fig., 1967 (as *Poloniodiscus fischeri*). This paper figs. 9, 10, 32.

Specimens examined: AUSTRIA: [on duff], Exposition Sharnstein, F. Candoussau, 3. IX. 1973, R. P. Korf Pers. Herb. 4161 (filed under

Cordierites irregularis).

CANADA: on *Betula lutea*, old log, Bear Island, L. Temagami, T.F.R., Ont., R. F. Cain, 6. IX. 1933, NY-U. Toronto Crypt. Herb 4775; on much decayed log, Gull Lake Portage, Lake Temagami, T.F.R., Ont., H. S. Jackson, et al., 6. VIII. 1931, NY-Univ. Toronto Crypt. Herb. 2577.

POLAND: in silva virginea ad truncum iacentem arboris frondosae, Bialowieza, W. Fischer, 5. IX. 1966, PRM 668120 (holotype of *Poloniodiscus fischeri*), CUP 49571 (ex PRM 668120, isotype).

SOVIET UNION: on rotten angiosperm wood, regio Primorsk Sudzuhhe reservate, Sapnagon, U.R.S.S., A. Raitviir 42641, 7. IX. 1961, R. P. Korf Pers. Herb. 3356.

UNITED STATES: (no substrate), Bethlehem, Syn. 759, (no collector), (no date), PH (holotype), BPI (isotype) (as *Peziza irregularis*); on rotten wood, White Mts., N. H., Miss S. Minns, IX. 1884, NY (holotype of *Peziza doratophora* Ellis & Ev.), NY (isotype, including 1 specimen and 1 drawing by Massee); on hickory wood, Preston, Ohio, A. P. Morgan, 27. X. 1892, CUP-D 2122 (15-10) (misidentified as *Midotis plicata*); on maple log, North Elba, N. Y., C. H. Peck, 11. IX. 1905, NY (in 2 packets) (as *Midotis irregularis*); on charred wood, Phelps Estate, Hackensack, N. J., B. O. Dodge & C. A. Darling, X. 1910, NY (as *Peziza doratophora*); on dead wood, maple & alder woods, Corvallis, Oregon, H. M. Q., 20. X. 1919, NY (as *Peziza irregularis*); on side of log, in a wood, near Oxford, Ohio, B. T., 25. X. 1926, NY; on damp soil?, Hood River, Ore., J. R. Kienholz, 15. IX. 1932, NY; [on rotten wood], Bass Lake, Oakland Co., Michigan, A. H. Smith 7636, 21. IX. 1937, NY; on log, Warren Woods State Park, Berrien Co., Michigan, C. T. Rogerson 3748, 4. IX. 1955, NY (as *Midotis irregularis*); on mossy area, Saranac Lake, 3 mi W on Forest Home Rd., R. Luck, 11. IX. 1965, NY-KPD 63; on wood, Mianus Gorge Nature Reserve, southeast of Bedford Village, Westchester County, New York, K. P. Dumont, 7. X. 1970, NY ; on wood, SUNY Camp. Ashokan, New York, R. P. Korf, et al., 9. IX. 1972, R. P. Korf Pers. Herb. 4179; on *Acer saccharinum*, Lumberman's Bay, Huron Mtn. Club, Big Bay, Marquette Co., Mich., H. H. Burdsall, Jr. 8257, 9. VIII. 1974, R. P. Korf Pers. Herb. 4283 (filed under *Cordierites irregularis*); on rotten log, Ward Poundridge Reservation, Westchester County, New York, C. T. Rogerson & S. T. Carey, 1. X. 1975, NY (filed under *Cordierites irregularis*); on very rotten log, Audubon Center, Greenwich, Fairfield County, Connecticut, C. T. Rogerson & S. T. Carey, 2. X. 1975, NY (filed under *Cordierites irregularis*); on rotten log, woods, White Memorial Foundation, Litchfield, Connecticut, C. T. Rogerson (3rd COMA foray), 30. IX. 1978, NY (filed under *Cordierites irregularis*); on log, Elyria, Lorain County, Ohio, S. Ristich, 25. IX. 1982, NY; on log, Muscoot Nature Reserve, near Katonah, Westchester County, New York, S. Stein, 7. X. 1984, NY; on log, Woodlawn Park, Darien, Connecticut, S. Sheine, 15. X. 1984, NY; on wood, Ringwood, Ithaca, New York, L. Sachett, 8. X. 1987, CUP 61833.

Notes: This species was designated as the type of *Ionomidotis* by Korf (1958). This fungus is easily distinguished from other species of *Ionomidotis* by the very large (up to 50 x 40 mm), lobed, ear- to fan-shaped apothecia, ellipsoid ascospores, and the paraphyses with a lanceolate, acute tip.

IONOMIDOTIS OLIVASCENS Durand, Proc. Amer. Acad. Arts 59: 13, 1923. (Figs. 11, 12, 33)
≡ *Midotis olivascens* (Durand) Seaver, N. Amer. Cup-fung. (Inop.). p. 94, 1951.

Apothecium discoid with one side elongated to ear-shaped, up to 6 mm in diam when dry, gregarious, shortly stipitate; tissues strongly ionomidotic in KOH; hymenium black when dry (blackish olive with a yellowish tint when fresh according to Durand); receptacle concolorous, surface smooth (granular or nearly smooth according to Durand). Ectal excipulum of textura intricata, gradually running into the medullary excipulum, immersed in a gel matrix; cells elongated to ellipsoid, cells in the outermost layer with a rounded and swollen apex, axes of cells nearly perpendicular to the outer surface, cell walls subhyaline, receptacle non-pustulate. Medullary excipulum of textura intricata, tissues immersed in gel; hyphae loosely interwoven, hyphal walls subhyaline, cytoplasm pigmented. Subhymenium not well-developed. Asci 8-spored, clavate, J– in Melzer's reagent, 39-47 x 4.2-4.8 µm, arising from croziers, immersed in gel. Ascospores allantoid to rod-shaped, irregularly uniseriate to irregularly biseriate, mostly biguttulate, 5.1-6.0(-7.0) x 1.5-2.2 µm (7-8 x 3 µm according to Durand). Paraphyses filiform, curved at apex, immersed in gel matrix, 1.0-1.5 µm wide, exceeding asci 7-8.5 µm.

On rotten wood associated with *Hypoxylon* sp.

Illustrations: Durand, E. J., Proc. Amer. Acad Arts 59: pl.1, pl. 2, fig. 10, 1923. This paper figs. 11, 12, 33.

Specimens examined: JAMAICA: on bark of a fallen, corticated branchlet, associated with *Hypoxylon* sp., North of Hampton School, Mt. Pleasant, Santa Cruz Mountains, St. Elizabeth Parish, elev. 2250 ft., R. P. Korf, T. Iturriaga, & W.-y. Zhuang, 10. XII. 1986, CUP-MJ 1032.

UNITED STATES: on rotting wood, Cocoanut Grove, Florida, R. Thaxter 111, XI. 1897, CUP-D 10571 (15-18) (isotype, marked as "cotype" by Durand); on rotting wood, Cocoanut Grove, Florida, I. 1898, FH (?holotype).

Notes: The non-pustulate receptacle surface of this fungus is very similar to that of *Ionomidotis fulvotingens*, but the latter has small, discoid apothecia, clearly differentiated ectal excipulum and medullary excipulum. *I. olivascens* has larger, ear-shaped apothecia, no sharp delimitation between ectal excipulum and medullary excipulum, and the medullary hyphae extend to give rise to the ectal excipulum. The type specimen is on rotten wood colonized by a *Hypoxylon* species, and so is the collection from Jamaica.

Durand (1923) noted the similarities between this fungus and *Chlorencoelia versiformis* (as *Chlorosplenium versiforme*), but the tissues of the latter are never immersed in gel, and marginal structures of apothecia in these two species are quite different.

The ascospores of the Jamaican collection were shot on to a Petri dish of potato dextrose agar (PDA), but no germination was detected after several months.

In his publication, Durand (1923) indicated that the type was collected in November, 1897, and on deposit in FH; but the collecting date of what appears to be the type specimen in FH is marked January, 1898. The isotype, CUP-D 10571, has the published date on the specimen label.

IONOMIDOTIS PORTORICENSIS Seaver, Mycologia 17: 50, 1925. (Figs. 13, 14, 34)

Apothecium discoid to cupulate when dry, 4 mm in diam when dry (5-8 mm in diam when fresh according to Seaver), gregarious, sessile to subsessile; tissues strongly ionomidotic in KOH; hymenium nearly black; receptacle very dark brown, surface wrinkled when dry. Ectal excipulum of textura angularis to textura intricata, 15-25 µm thick; cells elongated to rectangular, axes of cells nearly perpendicular to or at a small angle to the outer surface, cell walls slightly thickened, pale yellow, outermost cells loosely interconnected, sheathed by a gel layer, inner cells immersed in a gel matrix; receptacle minutely pustulate. Medullary excipulum of textura intricata, tissues immersed in gel; hyphae loosely interwoven, coarse, 3-5 µm wide, becoming finer close to hymenium, hyphal walls subhyaline. Subhymenium not clearly distinguishable. Asci 8-spored, clavate, J– in Melzer's reagent, 37-44(-50) x 3.7-4.2 µm (30 x 5 µm according to Seaver), immersed in gel. Ascospores rod-shaped, allantoid to ellipsoid, biseriate to irregularly biseriate, biguttulate, 5.3-6.5 x 1.5-1.8 µm. Paraphyses filiform, straight, rarely faintly curved, slightly enlarged at apex, immersed in a gel matrix, 1.5-2.0 µm wide, slightly exceeding asci.

On dead wood.

Illustration: This paper figs. 13, 14, 34.

Specimen examined: PUERTO RICO: on wood, F. J. Seaver & C. E. Chardon, 24. I. to 5. IV. 1923, NY-Porto Rico 270 (holotype).

Notes: This species has been inexplicably synonymized with *I. nicaraguensis* by Seaver (1951). My type studies have shown that *I. portoricensis* differs significantly from *I. nicaraguensis* in apothecial size (4 mm *vs.* 10 mm when dry), size of asci and of ascospores (asci 37-47 x 3.7-4.2 µm *vs.* 160-170 x 6.5-8.0 µm, and ascospores 5.3-6.5 x 1.5-1.8 *vs.* 13.4-17.8 x 5.0-6.1 µm), and elongated to rectangular ectal excipular cells which are pale yellow and immersed in gel *vs.* isodiametric excipular cells which are brown and not immersed in gel.

The distinction between *I. portoricensis* and *I. chilensis* has been discussed above. *I. portoricensis* differs from *I. olivascens* in the discoid instead of ear-shaped apothecium, ectal excipulum of textura angularis to textura intricata instead of textura intricata, loosely interwoven and wide medullary hyphae which are distributed among a great amount of gel, and wider, slightly bent paraphysis apices.

4. Excluded Species

Ionomidotis fuscobrunnea (Pat. & Gaill.) Dennis, Kew Bull. Addit. Ser. 3, p. 345, 1970.
≡ *Helotium fuscobrunneum* Pat. & Gaill., Bull. Soc. Mycol. France 4: 101, pl. 18, fig. 8, 1888.
≡ *Rutstroemia fuscobrunnea* (Pat. & Gaill.) Le Gal, Discom. Madag. p. 325, fig. 147, 1953.
≡ **Encoelia fuscobrunnea** (Pat. & Gaill.) Zhuang, **comb. nov.** (Fig. 23)

Specimen examined: sur écorce d'arbre, Rive Gauche de l'Orénoque entre Maipures et San-Fernando, Venezuela, [M. A. Gaillard], 16. VIII. 1887, FH-Herb. Patouillard 240 (holotype, filed under *Helotium fuscobrunneum*).

Notes: The holotype of this species in FH has been examined. The excipular tissues turn strongly purple in KOH solution but the pigmentation only faintly exudes from the tissues. The apothecial anatomy of the type specimen shows that it is a species of *Encoelia.*

Ionomidotis nicaraguensis Durand, Proc. Amer. Acad. Arts 59: 11, pl. 1, pl. 2, fig. 8, 1923.
≡ *Midotis nicaraguensis* (Durand) Seaver, N. Amer. Cup-fung. (Inop.). p. 93, 1951 (as '*Midotia*').
≡ **Encoelia nicaraguensis** (Durand) Zhuang, **comb. nov.** (Fig. 25)

Specimens examined: on rotten logs, Volean Mombacho, Dept. of Grenada, Nicaragua, C. F. Baker 2500, 20. II. 1903, FH (holotype), CUP (isotype) (both filed under *Ionomidotis nicaraguensis*).

Notes: I have looked at the holotype specimen on deposit in FH, and the isotype in the Durand Herbarium of CUP. The appearance of this fungus is somewhat similar to *Encoelia heteromera,* and it was so identified on packet label. The sizes of asci and of ascospores of this fungus are much larger than those of *E. heteromera*. It is not conspecific but is congeneric with *E. heteromera*. The fungus is presumably xanthochroic, since the pigmentation exuded from the tissues is yellowish brown instead of violet, as it would be in the typically ionomidotic species.

Ionomidotis plicata (Phill. & Hark.) Durand, Proc. Amer. Acad. Arts 59: 12, pl. 1, pl. 2, fig. 9, 1923.

Notes: The excipular structure of this species is different from that of *Ionomidotis*, but very similar to *Ameghiniella*. We transfer this fungus to *Ameghiniella*, discussed below on page 287.

Ionomidotis urceolata Durand, Proc. Amer. Acad. Arts 59: 14, pl. 1, pl. 2, fig. 12, 1923.
≡ **Encoelia urceolata** (Durand) Zhuang, **comb. nov.** (Figs. 26, 27)

Specimens examined: (no substrate), Palm Beach, Florida, USA, R. Thaxter 110, XII. 1897, FH (holotype); on rotting wood, Palm Beach Florida, USA, R. Thaxter 110, XII. 1897, CUP-D 10570 (15-22) (isotype) (both filed under *Ionomidotis urceolata*).

Notes: I have studied the holotype of this species in FH and the isotype in the Durand Herbarium of CUP. This fungus is somewhat ionomidotic in KOH solution but the ectal excipular cells are more or less isodiametric, dark, loosely arranged in rows, and not immersed in gel. The excipular structure at the flanks of this fungus resembles *Encoeliopsis rhododendri* (Ces.) Nannf., but the ascospores are 1-celled instead of 2-celled. It is neither a species of *Ionomidotis* nor a species of *Cordierites*. Cells in the outer layers of the excipulum connect to each other very loosely. I treat it as a member of *Encoelia.*

THE GENUS *CORDIERITES*

1. Generic Description

CORDIERITES Mont., Ann. Sci. Nat., Bot. Sér. 2, 14: 330, 1840.
= *Phyllomyces* Lloyd, Mycol. Writings C. G. Lloyd 6: 1057, 1921.

Apothecia discoid, infundibuliform, or ear-shaped, stipitate, usually with branched stipes, receptacle especially at margin covered with light brown to brown, subcylindrical, very short to long hyphal protrusions extending at an acute angle to the outer surface, receptacle surface slightly pustulate, apothecial tissues non-ionomidotic or ionomidotic. Ectal excipulum of textura angularis, tissues not immersed in gel, cells isodiametric to ellipsoid, cell walls brown. Medullary excipulum of textura intricata, hyphae at flanks parallel to the outer surface, hyphal walls light brown to brown. Subhymenium often distinguishable, of textura intricata. Asci inoperculate, 8-spored, subcylindrical, J–, pore walls not turning blue in Melzer's reagent with or without KOH pretreatment. Ascospores uniseriate, ellipsoid, hyaline, smooth-walled, unicellular, biguttulate.

Paraphyses filiform, subcylindrical, usually not exceeding asci.

On wood, sometimes associated with other fungi.

Type: *Cordierites guianensis* Mont.

2. Key to the Accepted Species

1. Apothecium ear-shaped, infundibuliform, or discoid with one side strongly elongate, stipes arising from a common base or branched, tissues strongly ionomidotic .... *C. sprucei*

1'. Apothecium discoid, or discoid with one side somewhat elongate, stipe well-branched, tissues faintly ionomidotic or not 2

  2. Apothecium 1-3 mm in diam, ectal excipulum of well-developed textura angularis, hair-like hyphal protrusions absent, often associated with xylariaceous fungi .... *C. guianensis*

  2'. Apothecium more than 3 mm, up to 20 mm, in diam, ectal excipulum of poorly-developed textura angularis, hair-like hyphal protrusions covering the receptacle surface .... *C. boedijnii*

3. Accepted Species

Cordierites boedijnii Zhuang, **sp. nov.** (Figs. 18, 19)

≡ [*Midotis boedijnii* Cifer., Ist. Bot. Real Univ. Reale Lab. Crittog. Pavia Atti, Ser. 5, 14: 269, 1957, nom. nud.]

Misapplication:

Cordierites guianensis Mont. sensu Boedijn, Bull. Jard. Bot. Buitenzorg Ser. 3, 13(4): 527, 1936.

Ab C. guianensi apothecio magno (2-20 mm in diam. vs. 1-3 mm in diam.), prominentibus hyphalibus (usque ad 100 µm longis) quae in receptaculi superficie adsunt, excipulo ectali mediocriter evoluto, atque praesentia in ligno recta vicem societatis cum fungis xylariaceis differens.

Apothecium cupulate, lobed, or discoid with one side elongated, 2-5 mm in diam (apothecium 2-20 mm in diam, and the entire fructifications 20-30 mm high, 10-30 mm broad according to Boedijn, 1936), gregarious, margin enrolled when dry, stipitate, stipes branched, arising from a stroma-like basal trunk, stipes near the base coarse, the final branches ending with an apothecium, tissues not ionomidotic in KOH; hymenium nearly black when dry; receptacle and stipes very dark brown, surface strongly roughened when dry. Ectal excipulum of textura angularis, very thin; cells in the outermost layer giving rise to long, hair-like hyphal protrusions, up to 100 µm long at margin, shorter at flanks and near base, hyphal protrusions septate, cylindrical, with a blunt apex, extending at an acute angle to the receptacle surface, walls pale brown to yellow; tissues not immersed in gel. Medullary excipulum of textura intricata, ca. 125 µm thick at flanks; hyphae parallel to the outer surface, hyphal walls brownish, tissues not immersed in gel. Subhymenium of textura intricata, paler than medullary excipulum, 20-30 µm thick. Asci 8-spored, subcylindrical, J– in Melzer's reagent, ca. 50-60 x 4.4-5.0 µm (47-50 x 4-6 µm according to Boedijn, 1936). Ascospores ellipsoid, uniseriate, biguttulate, 4.9-6.3 x (2.0-)2.2-2.5 µm. Paraphyses filiform, straight, a few slightly bent at apex, 1.0-1.5 µm wide, not exceeding asci.

On wood.

Holotype: on wood, G. Gedeh, Tjibodas, Java, Indonesia, Bruggeman, 1925, BO 9387, R. P. Korf Pers. Herb.-SA 519 (isotype, ex BO 9387) (filed under *Cordierites guianensis*).

Illustrations: Boedijn, K. B., Bull. Jard. Bot. Buitenzorg, Ser. 3, 13: 526-527, figs. 1, 2, 1936 (as *Cordierites guianensis*). This paper figs. 18, 19.

Other specimen examined: INDONESIA: on wood, Krakatau, Z. Oost., Boedijn, 7. IV. 1934, R. P. Korf Pers. Herb.-SA 518 (ex BO 14422) (filed under *Cordierites guianensis*).

Notes: When Boedijn (1936) published a paper referring to the generic concept of *Cordierites,* he described and illustrated his own collections from Java to exhibit the morphology of the type species of this genus, *C. guianensis* Mont. He stated that the Javanese material does not represent a new species, that it is not specifically distinct from the type species, and that the genus consists of one species and all other described species (*C. sprucei*, *C. muscoides*, *C. coralloides*, *C. fasciculata*, and *C. umbilicarioides*) must be reduced to synonyms of *C. guianensis*. Dennis (1955), Ciferri (1957) and Rifai (1977) have thrown doubt on Boedijn's synonymy of *C. guianensis*.

Judging from Boedijn's description of the Javanese "*C. guianensis*," Ciferri concluded that Boedijn's material was different from, and not congeneric with, Montagne's *C. guianensis*, and that it was a species of *Midotis*. A new species (as a new name) was created by him as *Midotis boedijnii* (Ciferri, 1957), but he failed to provide a Latin diagnosis, which makes *M. boedijnii* a nomen nudum.

The type specimen and an authentic collection of *C. guianensis* have been examined and compared with the two collections from Java which had been cited in Boedijn's paper (Boedijn, 1936). Although both fungi share features of gross morphology, such as branched stipes, a discoid apothecium on the tip of each stipe branch, and shape of asci and of ascospores, the ectal excipular structures are different. The true *C. guianensis* has short, slightly elongated cells at the apothecial margin which are not hair-like, and the excipular cells in the outer layers are arranged in rows at an acute angle to the exterior where they form low pustules on the receptacle surface. Boedijn's "*C. guianensis*" has very long marginal hyphae which are hair-like, up to 100 µm long, covering the receptacle surface, and extend toward the outside at an acute angle to the outer surface, and the receptacle surface is not obviously pustulate. The true *C. guianensis* has smaller apothecia and finer stipes than Boedijn's material does. Although I agree with Ciferri that Boedijn's material from Java is not conspecific with Montagne's original one from Guyana, they are congeneric.

CORDIERITES GUIANENSIS Mont., Ann. Sci. Nat. Bot., Sér. 2, 14: 331, 1840. (Fig. 20)
? = *Cordierites coralloides* Berk. & Curt., J. Linn. Soc. Bot. 10: 370, 1868.
≡ *Graphium coralloides* (Berk. & Curt.) Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 118: 894, 1909 (excluding description).

Apothecium cupulate to discoid, gregarious, stipitate, ca. 1 mm in diam when dry (up to 3 mm in diam according to Rifai), stipes well-branched, terete; tissues not ionomidotic in KOH; hymenium dark brown to olivaceous; receptacle dark brown, lighter at margin, surface roughened to furfuraceous when dry. Ectal excipulum of textura angularis, not immersed in a gel matrix; cells isodiametric to elongate, cell walls light brown; receptacle slightly pustulate, cells in pustules more or less isodiametric, walls brown. Medullary excipulum of textura intricata, tissues not immersed in gel; hyphae parallel to the outer surface, walls yellowish brown. Subhymenium of textura intricata, 29-35 µm thick. Asci 8-spored, subcylindrical, J– in Melzer's reagent, asci 4.0-4.5 µm wide, hymenium ca. 70-80 µm thick. Ascospores ellipsoid, uniseriate, biguttulate, walls yellowish, 4.4-6.2 x 2.1-2.2 (-2.5) µm. Paraphyses filiform, straight, 1.5 µm wide, not exceeding asci.

On wood associated with xylariaceous fungi.

Illustrations: Montagne, C., Ann. Sci. Nat. Bot., Sér. 2, 14: pl. 19, fig. 11, 1840. Corda, A. K. J., Anleit. Stud. Mycol., Taf. G, 64, figs. 40-42, 1842. Montagne, C., Ann. Sci. Nat. Bot., Sér. 4, 3: tab. 6, fig. 6, 1855. Payer, J., Bot. Cryptog. p. 64, figs. 273-274; p. 89, figs. 408-409, 1868. Massee, G., J. Linn. Soc. Bot. 31: pl. 18, fig. 3, 1897 (as *Cordierites coralloides*). Dennis R. W. G., Kew Bull. 1955: 366, fig. 3, 1955; Kew Bull. Addit. Ser. 3, fig. 7, H, 1970. Ciferri, R., Ist. Bot. Real Univ. Reale Lab. Crittog. Pavia Atti Ser. 5, 14: pl. 2, 1957. Rifai, M. A., Kew Bull. 31: 725, fig. 1, 1977 (as *Cordierites coralloides*). This paper fig. 20.

Specimens examined: COLOMBIA: on indet. Xylariaceae on log, ca. 29 miles from Florencia on the Florencia-Altamira Road, Intendencia Caqueta, elev. ca. 4000 ft., K. P. Dumont, P. Buritica, J. L. Luteyn, & L. A. Molina, 18. I. 1976, NY-Dumont-CO 3023.

CUBA: (no substrate), C. Wright 504, K, NY-KPD 2035 (ex K); (no substrate), (no collector), NY-from the Herbarium of George Massee, purchased 1905 (filed under *Cordierites coralloides* B. & C.) (? part of the original material of *C. coralloides*).

GUYANA: ad truncos putridos [?associated with a xylariaceous fungus], Leprieur, XI. 1837, no. 383, PC (holotype of *Cordierites guianensis*), NY-KPD 2017 (isotype, ex PC no. 383); on wood, Rio des Cascades, Leprieur, I. 1843, no. 885 (Crypt. Guyan. no. 578), PC, NY-KPD 2018 (ex PC no. 885).

Notes: This is the type species of *Cordierites*. The specific name was used in a very broad sense by Boedijn (1936) and in a narrower sense by Ciferri (1957), even though both authors claimed the genus to be monotypic. As indicated earlier, Boedijn's concept of *C. guianensis* was based not on a type study but totally on the collections from Java. Ciferri's concept of this species seems to be established on the basis of type examination. But as he mentioned in his paper, what he had really seen was the specimen label, notes, branched stipes, small fragments of stipitate ascocarps, pencil drawings of ascocarps and of ascospores, and black dust in a packet containing two kinds of hyaline spores. In other words, he did not examine the structure of this fungus but only the gross morphology and description.

Through the courtesy of Muséum National d'Histoire Naturelle, Paris (PC), and the New York Botanical Garden (NY), I was able to examine the type specimen (#383) and another authentic specimen (#885), both determined as *Cordierites guianensis* by Montagne (1840, 1855). As indicated by Ciferri (1957) they were in very poor condition. I found, among branched stipes of #383 on deposit in PC, a poorly-preserved and possibly parasitized apothecium, and made microtome sections from it. The sections have been mounted in dilute commercial mucilage, and returned to the packet. The isotype of this species in NY, in slightly better condition, contains a portion of a stipe and a fragment of an apothecium glued on a small piece of paper, as well as sections showing the margin and flank of an apothecium which were made by K. P. Dumont some years ago. #885 in NY (ex PC), which is well-preserved, has sections of a portion of an apothecium, and a small branched stipe bearing an apothecium. These materials gave me much more information than Ciferri's paper. A recent collection of *C. guianensis* from Colombia, associated with a xylariaceous fungus, on deposit in NY (Dumont-CO 3023) was also examined. The gross morphology and anatomical structure of the Colombian collection match those of Montagne's material from Guyana.

When Rifai (1977) restudied *C. coralloides*, which occurs on *Ustulina deusta*, he disagreed with Boedijn's synonymy of this species with *C. guianensis*, and pointed out that it was an independent species. According to Rifai, *C. guianensis* grows on a different type of substrate from *C. coralloides*. My studies have shown that the structure of both type specimens is very similar, and that many xylariaceous spores were also present on the apothecium of the type of *C. guianensis*. I suspect that the type specimen of *C. guianensis* was associated with a fungus which we have not seen, either because the substrate no longer exists in the packet, or because it was never picked up by the original collector. My conclusion is that *C. coralloides* is a later synonym of *C. guianensis*.

In response to my request to the Royal Botanic Gardens, Kew, England for the type of *C. coralloides*, the holotype was not sent, but another specimen in the type folder, "Wright 504." According to Rifai (1977), no fungal material remains in the holotype (Wright 326), only a detailed water color drawing by Phillips labelled "from Wright in Herb. Berk. no. 326," and the illustration clearly depicts linear asci and spores. When Höhnel (1909) examined the holotype of *C. carolloides*, he did not find the discomycete but an imperfect fungus on the substrate, and mistakenly transferred *C. carolloides* to the hyphomycete genus, *Graphium*. The hyphomycete was later described as *Dennisographium episphaeriae* Rifai (1977).

CORDIERITES SPRUCEI Berk., Hooker's J. Bot. Kew Gard. Misc. 8: 280, 1856. (Figs. 21, 22)
≡ *Ionomidotis sprucei* (Berk.) Durand, Proc. Amer. Acad. Arts 59: 13, 1923.
? = *Cordierites fasciculata* Möll., Bot. Mitt. Tropen 9: 278, 1901.
≡ *Midotis fasciculata* (Möll.) Cifer., Ist. Bot. Real Univ. Reale Lab. Crittog. Pavia Atti Ser. 5, 14: 269, 1957.
= *Cordierites umbilicarioides* Möll., Bot. Mitt. Tropen 9: 279, 1901.
≡ *Ionomidotis umbilicarioides* (Möll.) Le Gal, Bull. Jardin Bot. État. 29(2): 120, 1959, nom. superfl.
= *Phyllomyces multiplex* Lloyd, Mycol. Writings C. G. Lloyd 6: 1057, 1921.

Apothecium discoid with one side elongated, infundibuliform, or ear-shaped, gregarious or solitary, stipitate, 2-12 mm wide and up to 20 mm high, stipes branched, sometimes arising from a common base; tissues strongly ionomidotic in aqueous KOH solution; hymenium very dark purplish brown to nearly black; receptacle concolorous with hymenium, surface furfuraceous and pustulate. Ectal excipulum of textura angularis, very thin; cells isodiametric to ellipsoid, walls pigmented, cells in the outermost layer giving rise to short hyphal protrusions; receptacle pustulate, cells in pustules isodiametric, walls pigmented. Medullary excipulum of textura porrecta to textura intricata, 65-140 μm thick at flanks; hyphae parallel to the outer surface, walls smooth and light brown. Subhymenium clearly distinguishable, of textura intricata, 28-60 μm thick. Asci 8-spored, subcylindrical, J– in Melzer's reagent, ca. 60-75 x 4.0-4.5(-5) μm. Ascospores ellipsoid, uniseriate, biguttulate, 3.7-5.1 x 2.1-3.0 μm. Paraphyses filiform, straight at apex, 1.5-2.0 μm wide, not exceeding asci.

On wood.

Illustrations: Berkeley, M. J., Hooker's J. Bot. Kew Gard. Misc. 8: pl. 10, fig. 5, 1856. Massee, G., J. Linn. Soc. Bot. 31: pl. 18, figs. 4, 5, 1897. Lloyd, C. G., Mycol. Writings C. G. Lloyd 6: fig. 1975, 1921 (as *Phyllomyces multiplex*). Durand, E. J., Proc. Amer. Acad. Arts 59: pl. 2, fig. 11, 1923 (as *Ionomidotis sprucei*). Ciferri, R., Ist. Bot. Real Univ. Reale Lab. Crittog. Pavia Atti Ser. 5, 14: pl. 1, fig. 10 (as ? *Midotis occidentalis*), figs. 13-15 (as *Midotis fasciculata*) 1957. Le Gal, M., Bull. Jardin Bot. État. 29(2): 121, 123, figs. 20, 21, 1959; Flore Icon. Champ. Congo fasc. 9, pl. 31, fig. 7, 1960 (color illustration by M. Goossens-Fontana) (as *Ionomidotis umbilicarioides*). This paper figs. 21, 22.

Specimens examined: BRAZIL: in truncis putridis, Panuré, Spruce 85, (no date), K-Herb. Berk. (holotype of *Cordierites sprucei*), CUP-D 4165 (15-20) (? isotype, marked as "cotype"), NY (a drawing by Massee from type), NY-KPD 2034 (isotype, ex K); (no substrate), Spruce, (no date), CUP-D 7514 (15-21); (no substrate), Spruce, (no date), NY-from the Herbarium of George Massee, purchased 1905.

COLOMBIA: on dead wood, Caño Unguya, Rio Apaporris, Vaupes, R. E. D. Baker, 9. IV. 1952, K (filed under *Cordierites guianensis*); on indet. log, ca. 29 miles from Florencia on the Florencia-Altamira Road, Intendencia Caqueta, elev., ca. 4000 ft., K. P. Dumont, P. Buritica, J. L. Luteyn, & L. A. Molina, 18. I. 1976, NY-Dumont-CO 3026.

PHILIPPINES: on dead wood, Mt. Maquiling, Luzon, P.I., B. Corsino, 28. IX. 1920, Lloyd 7283, BPI (holotype of *Phyllomyces multiplex*), R. P. Korf Pers. Herb. 4006 (isotype, ex BPI).

SIERRA LEONE: on dead trunk of *Mangifera indica*, Njala, (no collector), 11. III. 1954, K-M6279 (filed under *Cordierites guianensis*).

SOVIET UNION: on rotten angiosperm wood, regio Primorsk, Sudzukhe reservate, Sandagon, U.R.S.S., A. Raitviir (42650), 7. IX. 1961, R. P. Korf Pers. Herb. 3359.

VENEZUELA: (no substrate), trail from Los Pocitos 1 1/2 hours walking toward Santa Isabel, NW Irapa, Edo Sucre, K. P. Dumont, R. F. Cain, G. J. Samuels, G. Morillo, & J. Farfan, 11. VII. 1972, NY-Dumont- VE 7313.

Notes: This fungus was transferred from *Cordierites* to *Ionomidotis* by Durand (1923) because of the presence of ionomidotic reaction. Structurally it is quite different from the species of *Ionomidotis* but similar to *C. guianensis*, except for the elongated outer cells on the receptacle surface and at the margin which are short, non-septate, hyphal protrusions, never appearing as long as the hyphal protrusions of *C. boedijnii*. Though the ionomidotic reaction is a useful and important tool in classification, fungi other than *Ionomidotis* species have also been reported to be ionomidotic (Korf, 1958; Ouellette & Korf, 1979).

C. umbilicarioides Möll. from Brazil and *Phyllomyces multiplex* Lloyd from the Philippines are later synonyms. Although the apothecia of the types of these two species are larger, they are structurally indistinguishable from *C. sprucei* in Brazil. The Philippine material has higher pustules on the receptacle surface than material from Brazil. I do not treat this as a character at specific level.

The comments made by Ciferri (1957) on *C. sprucei* are very confusing, and probably not based on a careful study. He stated that "in our opinion, may be that *C. sprucei* and *C. lateritia* are the same species, based on imperfect ripeness stage or imperfect description," and later in the same paper that *C. sprucei* "may be doubtfully considered conspecific with *Midotis occidentalis*." The correct name of "*C. lateritia*" is *Encoelia heteromera* (Mont.) Nannf., which is different from *C. sprucei* both in structure and in gross morphology. *M. occidentalis* Durand is an interesting fungus with a J+ ascus iodine reaction and punctate ascospores, and is certainly not congeneric with *C. sprucei*.

The type specimen of *C. fasciculata* on deposit at B is in alcohol and cannot be borrowed, so that I failed to examine it. Le Gal (1959), however, has synonymized this fungus under *C. umbilicarioides*. I accept the synonymy of these two species as proposed by Ciferri (1957) and by Le Gal (1959) Le Gal incorrectly chose *umbilicarioides* as the specific epithet, since Ciferri had previously chosen *fasciculata* when he synonymized the two taxa.

4. Excluded Species

Cordierites acanthophora Samuels & Kohn, Sydowia 39: Figs. 1 A–C, 2 A–D, 1987 (in press).

Specimen examined: on ground, Auckland, Waitemata City, Waitakere Ranges, at junction of Old Coach Road and Fairy Falls Track (from the same site as type collection: G.J.S.), G. J. Samuels & A. Y. Rossman, 4. VI. 1983, NY (ex PDD 46300, filed under *Cordierites acanthophora*).

Notes: A specimen in NY (ex PDD 46300) identified by Dr. Samuels (one of the original authors) has been examined. This is a very special and interesting fungus, its apothecia scattered on a cylindrical stalk bearing thorn-like pycnidia. Samuels and Kohn (1987) have given a very detailed description and illustration. It is obviously a fungus in the Encoelioideae but neither in *Ionomidotis* nor in *Cordierites*. The loosely interconnected, subglobose excipular cells, and J+ ascus iodine reaction remind me of the genus *Encoelia*. The other features, especially the very large, fusoid, ornamented ascospores, and thorn-like pycnidia seated on the stalk, do not fit the genus *Encoelia*. I have no position for it. It might represent a new genus.

Cordierites concrescens (Schw.) Cooke, Bull. Buffalo Soc. Nat. Sci. 3: 26, 1875.

≡ *Peziza concrescens* Schw., Trans. Amer. Philos. Soc. 4: 171, 1832.

Specimen examined: [on rotten wood], Salem, Bethlehem, (no collector), 1829, PH-Schweinitz, Syn. #755 (holotype, in two packets); among rotten wood, Salem, Bethlehem, BPI (isotype, ex Herb. Schw.).

Notes: The holotype and isotype specimens on deposit in PH and BPI have been examined. The fruit bodies of this fungus, firmly attached to a piece of wood, are buff-colored, and highly gelatinous to tremelloid, without any ionomidotic reaction. I cannot find a single ascus in the type material and wonder whether it is an ascomycete. I am convinced by my observations that it is not a *Cordierites.*

Failing to study Cooke's paper, Ciferri (1957) mistakenly thought that the basionym of *Cordierites concrescens* (Schw.) Cooke (1875) was *Sphaeria concrescens* Schw., and gave the wrong literature source. Actually, the epithet that Cooke (1875) transferred was based on *Peziza concrescens* Schw.

Cordierites frondosa (Kobayasi) Korf, Phytologia 21: 203, 1971.
≡ *Bulgaria frondosa* Kobayasi, Bot. Mag. (Tokyo) 53: 158, 1939.
≡ IONOMIDOTIS FRONDOSA (Kobayasi) Kobayasi & Korf in Korf, Sci. Rep. Yokohama Natl. Univ., Ser. 2, Biol. Sci. 7: 19, 1958.

Notes: This species has already been discussed earlier under *Ionomidotis.*

Cordierites indicus (Thind, Cash & Singh) Thind & Sharma, Bibl. Mycol. 91: 188, figs. 1, 2, 1983.
≡ *Midotis indica* Thind, Cash & Singh, Mycologia 51: 833, figs. 1, 4, 7, 10, 1959.
≡ **Chlorencoelia indica** (Thind, Cash & Singh) Zhuang, **comb. nov.** (Fig. 24)

Specimen examined: on *Cedrus deodara* wood, Khadrala, Mahasu, (H.P.), R. K. Singh, 26. VIII. 1971, BPI (ex PAN-Singh 3865, filed under *Midotis indica*).

Notes: Since the holotype of this species was not sent to me, a specimen (Singh 3865), which was identified by one of the original authors and which was cited by Sharma and Thind (1983) when the transfer to *Cordierites* was made, has been examined by me. I have compared very carefully the morphology of Singh 3865 with the original description and illustration of *Midotis indica*, and find that they match each other well. I treat this specimen as authentic.

The discoid to slightly infundibuliform, unequal-sided apothecia, excipular structure, especially the club-shaped cells in the outermost layer of the ectal excipulum, ellipsoid ascospores which have two large guttules, and the J+ ascus iodine reaction recall *Chlorencoelia versiformis*, the type species of *Chlorencoelia.* A transfer to *Chlorencoelia* is thus proposed.

Chlorencoelia indica may be similar to *Chlorociboria* species in the somewhat pustulate receptacle, but it can be distinguished by the clearly delimited subhymenium, ellipsoid ascospores with two large guttules, and failure to produce green stain in the substrate.

Cordierites irregularis (Schw.) Cooke, Bull. Buffalo Soc. Nat. Sci. 3: 26, 1875.
≡ *Peziza irregularis* Schw., Trans. Amer. Philos. Soc. 4: 171, 1832.
≡ IONOMIDOTIS IRREGULARIS (Schw.) Durand, Proc. Amer. Acad. Arts 59: 9, 1923.

Notes: This species has been discussed earlier in this paper under *Ionomidotis*.

"*Cordierites lateritia* Berk. & Curt." in Ciferri, Ist. Bot. Real Univ. Reale Lab. Crittog. Pavia Atti Ser. 5, 14: 266, 1957, nom. nud.
≡ ENCOELIA HETEROMERA (Mont.) Nannf., Trans. Brit. Mycol. Soc. 23: 239, 1939.

Specimens examined: (no substrate), Cuba, Wright 580, (no date), CUP-D 3581 (15-25) (marked as type, filed under *Cordierites lateritia* and *Midotis heteromera*); on rotten logs in dense woods, La Perla, C. Wright 580, (no date), NY (filed under *Cordierites lateritia*); on rotten logs, Cuba, Wright, V. 1857, FH-Curtis Herb. (filed under *Cordierites lateritia*).

Notes: The name "*Cordierites lateritia* B. & C." seems to never have been published by Berkeley and Curtis. In the Durand Herbarium of CUP, a specimen numbered CUP-D 3581 (15-25) (ex Wright 580) was marked "type" with a red pen by Durand. *Cordierites lateritia* first appeared in a note by Farlow in the paper by Durand (1923) which indicated "Was the name *Cordierites lateritia* ever published?" I have to ask the same question again. Although Ciferri (1957) used this "name," I could not and perhaps will never find where the name was published. I found that Wright 580 was clearly referred to by Berkeley and Curtis (1867) under the name *Midotis heteromera* (Mont.) Fr. My examinations of "*C. lateritia*" in CUP, FH, K, and NY have shown that it is conspecific with *Encoelia heteromera* (Mont.) Nannf. Ciferri (1957) used this "name" without explanation.

Cordierites muscoides Berk. & Curt. in Berk., Grevillea 4: 2, 1875.

Specimen examined: [on wood], Pennsylvania, Michener 4314, (no date), K (holotype).

Notes: The holotype (No. 4314) of this species at K has been examined. The fungus is on a small piece of wood. Its fruit bodies look like the branched stipes of *Cordierites*, but no apothecia can be found on any ends of these branches. The texture of these branches is corky and spongy, and the fruit bodies consist of brown, thick-walled fibers. By no means it is a discomycete; possibly it is basidiomycetous.

THE GENUS *AMEGHINIELLA*

1. Generic Description

AMEGHINIELLA Speg., Bol. Acad. Nac. Ci. 11(2): 270, 1888. (Fungi Fueg. p. 138, 1888).

Apothecium small to medium in size, gregarious, arising from a common base, deeply cupulate when dry, slightly asymmetrical, sessile; hymenium very dark brown, dark purple or black when dry; receptacle very dark purple to black when dry, surface pustulate; tissues usually ionomidotic. Ectal excipulum of textura angularis, cells pigmented, isodiametric to ellipsoid, very thick-walled, cells in the outer layers encoelioid; cells in the pustules isodiametric, loosely interconnected, thick-walled, walls light brown to brown, cells darker near apothecial base than at flanks and at margin. Medullary excipulum of textura intricata, hyphal walls subhyaline, yellowish to pale brown. Subhymenium not sharply distinguished from medullary excipulum, of textura intricata if present. Asci inoperculate, 8-spored, clavate, J– in Melzer's reagent. Ascospores allantoid to rod-shaped, biseriate to irregularly biseriate, subhyaline to yellowish, with several small guttules. Paraphyses filiform, slightly exceeding asci.

On branches of dead angiosperms.

Type: *Ameghiniella australis* Speg.

2. Key to the Accepted Species

1. Apothecium 4-15 mm in diam at maturity when dry, asci 36-40 x 3.5-3.7 µm, ascospores 5.0-6.5 x 1.0 µm .... *A. australis*
1'. Apothecium often less than 2 mm in diam at maturity when dry, asci 45-52 x 5.0-6.0 µm, ascospores 5.1-8.0(-8.8) x 1.5-2.0 µm ... *A. plicata*

3. Accepted Species

AMEGHINIELLA AUSTRALIS Speg., Bol. Acad. Nac. Ci. 11(2): 271, 1888. (Fungi Fueg. p. 139, 1888). (Fig. 15)

Apothecium deeply cupulate when dry, undulate-plicate, 4-15 mm in diam when dry, gregarious and arising from a common base, sessile; tissues strongly ionomidotic in KOH; hymenium black when dry; receptacle very dark brown to black when dry, surface granulate to pustulate. Ectal excipulum of textura angularis, 32-37 µm thick (excluding pustules), not immersed in gel; cells ellipsoid to subspherical, cell walls light brown, 1.0-1.2 µm thick, axes of cells perpendicular to the outer surface, cell contents brown; receptacle pustulate, cells in pustules subspherical, becoming loose at the tips of pustules, cell walls ca. 1.0-1.8 µm thick, light brown to brown. Medullary excipulum of textura intricata, 124-210 µm thick; hyphae not immersed in gel, slightly gelatinized, densely interwoven, hyphal walls light brown to brown. Subhymenium not clearly distinguishable. Hymenium ca. 50-52 µm thick. Asci 8-spored, clavate, J– in Melzer's reagent after 2% KOH pretreatment, ca. 36-40 x 3.5-3.7 µm (40-50 x 3-4.5 µm according to the original author). Ascospores allantoid, biseriate to irregularly biseriate, yellowish, multiguttulate, 5.0-6.5 x 1.0 µm (4.5-6 x 0.7-1 µm according to Spegazzini). Paraphyses filiform, sometimes curved at apex, slightly exceeding asci.

On dead branches of *Fagus betuloides.*

Illustration: This paper fig. 15.

Specimen examined: (no substrate), (no locality), (no collector), (no date), LPS 15709 (indicated by LPS as Typus) (note in the packet: this material is apparently part of the type).

Notes: This fungus is different from *Ionomidotis chilensis*. The distinctions between *Ameghiniella* and *Ionomidotis* has been discussed earlier in this paper.

The only specimen sent from the Spegazzini Herbarium bears no information on the packet except for "LPS 15709" and "Typus." Two small packets were found in the type. The packets contain different fungi. My description is based on one of them which fits the original description well. The other one is in a young stage, lacking asci in the hymenium. I am not certain whether it is the immature stage of *A. australis*, or more likely a different fungus which has greenish apothecia and which may be close to *Chlorociboria.*

Ameghiniella plicata (Phill. & Hark.) Zhuang & Korf, **comb. nov.** (Figs. 16, 17)

≡ *Midotis plicata* Phill. & Hark., Bull. Calif. Acad. Sci. 1: 24, 1884.

≡ *Ionomidotis plicata* (Phill. & Hark.) Durand, Proc. Amer. Acad. Arts 59: 12, 1923.

Apothecium deeply cupulate when dry (goblet-shaped, resembling a miniature *Urnula craterium* according to Durand, 1923), 1-2 mm in diam when dry, gregarious and arising from a common base, sessile; tissues strongly ionomidotic in KOH; hymenium very dark brown to dark purple when dry; receptacle concolorous with hymenium, surface pustulate. Ectal excipulum of textura angularis, not immersed in gel; cells in outer layers isodiametric, 7.5-15 µm in diam, cell walls thick, slightly roughened, light brown near margin and becoming brown at base, cell contents reddish brown, cells in inner layers ellipsoid, relatively thin-walled, pale brown to light brown; receptacle pustulate, cells in pustules spherical, very loosely interconnected, dark-walled near base. Medullary excipulum of textura intricata, tissues not immersed in gel, slightly gelatinized; hyphae densely interwoven, hyphal walls pale brown to yellowish. Subhymenium not clearly distinguishable from medullary excipulum, of dense textura intricata. Hymenium 75-85 µm thick. Asci 8-spored, clavate, J– in Melzer's reagent, 45-50 x 5.0-6.0 µm (65-70 µm long according to Durand, 1923). Ascospores rod-shaped to allantoid, biseriate to irregularly biseriate, yellowish, multiguttulate, 5.0-8.0(-8.8) x 1.5-2.0 µm. Paraphyses filiform, slightly enlarged at apex, ca. 2-3 µm wide at apex, exceeding asci by ca. 15 µm.

On wood of *Umbellularia californica.*

Illustrations: Durand, E. J., Proc. Amer. Acad. Arts 59: pl. 1, pl. 2, fig. 9, 1923 (as *Ionomidotis plicata*). Ciferri, R., Ist. Bot. Real Univ. Reale Lab. Crittog. Pavia Atti Ser. 5, 14: pl. 1, fig. 6, 1957 (as *Midotis plicata*). This paper figs. 16, 17.

Specimens examined: on *Umbellularia californica*, Sausalito, California, VIII. 1881, Harkness 2734, BPI (holotype), CUP-D 10761 (15-18a, and 15-19) (isotypes) (as *Midotis plicata*).

Notes: The gross morphology and anatomical structures indicate that it is a good species of *Ameghiniella*. It resembles *A. australis* in many aspects.

The isotype specimen on deposit in the Durand Herbarium in CUP is in a much better condition than is the holotype in BPI.

ACKNOWLEDGEMENTS

I deeply thank the directors and staff members of the following herbaria for sending the specimens on loan; without their assistance this work would never have been done: BPI, CUP, FH, K, LPS, MELU, NY, PC, PH, PRM, TNS; Dr. L. M. Kohn, Department of Biology, University of Toronto and Dr. G. J. Samuels, the New York Botanical Garden for consultation; Dr. L. M. Kohn also for serving as pre-submission reviewer; Dr. W. J. Dress, Bailey Hortorium, Cornell University for kindly providing the Latin diagnosis; Mr. K. E. Loeffler, Department of Plant Pathology, Cornell University for his assistance in preparing photographs. I acknowledge gratefully Prof. R. P. Korf, Department of Plant Pathology, Cornell University for his kind correction of English, numerous valuable suggestions, and pre-submission review of this paper.

FIGURES

Fig. 1. Transverse section of excipulum at flank of *Ionomidotis australis*; x 575, from holotype.

Fig. 2. Transverse section of apothecial margin of *Ionomidotis australis*; x 240, from holotype.

Fig. 3. Transverse section of excipulum at flank of *Ionomidotis chilensis*; x 575, from holotype.

Fig. 4. Transverse section of apothecial margin of *Ionomidotis chilensis*; x 240, from holotype.

Fig. 5. Transverse section of excipulum at flank of *Ionomidotis frondosa*; x 575, from neotype.

Fig. 6. Transverse section of apothecial margin of *Ionomidotis frondosa*; x 240, from neotype.

Fig. 7. Transverse section of excipulum at flank of *Ionomidotis fulvotingens*; x 575, from isotype.

Fig. 8. Transverse section of apothecial margin of *Ionomidotis fulvotingens*; x 240, from isotype.

Fig. 9. Transverse section of excipulum at flank of *Ionomidotis irregularis*; x 575, from R. P. Korf Pers. Herb 4283.

Fig. 10. Transverse section of apothecial margin of *Ionomidotis irregularis* (phase contrast); x 240, from R. P. Korf Pers. Herb. 4283.

Fig. 11. Transverse section of excipulum at flank of *Ionomidotis olivascens*; x 575, from holotype.

Fig. 12. Transverse section of apothecial margin of *Ionomidotis olivascens*; x 240, from holotype.

Fig. 13. Transverse section of excipulum at flank of *Ionomidotis portoricensis*; x 575, from holotype.

Fig. 14. Transverse section of apothecial margin of *Ionomidotis portoricensis*; x 240, from holotype.

Fig. 15. Transverse section of excipulum at flank of *Ameghiniella australis*; x 550, from LPS 15709.

Fig. 16. Transverse section of apothecial margin of *Ameghiniella plicata*, x 280, from isotype.

Fig. 17. Transverse section of excipulum at flank of *Ameghiniella plicata*, x 280, from isotype.

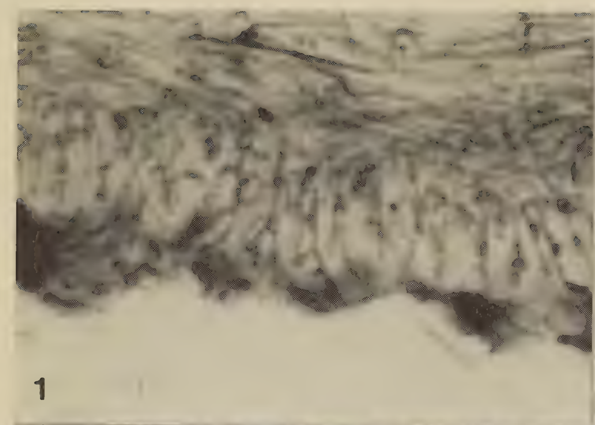
Fig. 18. Transverse section of apothecial margin of *Cordierites boedijnii* (phase contrast); x 240, from holotype.

Fig. 19. Transverse section of excipulum at flank of *Cordierites boedijnii* (phase contrast); x 240, from holotype.

Fig. 20. Transverse section of an apothecium at margin and at flank of *Cordierites guianensis* (phase contrast); x 240, from Wright 504.

Fig. 21. Transverse section of excipulum at flank of *Cordierites sprucei* (phase contrast); x 240, from holotype.

Fig. 22. Transverse section of apothecial margin of *Cordierites sprucei* (phase contrast); x 240, from holotype.
Fig. 23. Transverse section of excipulum at flank of *Encoelia fuscobrunnea*; x 280, form holotype.
Fig. 24. Transverse section of excipulum at flank of *Chlorencoelia indica*; x 280, from Singh 3865.
Fig. 25. Transverse section of ectal excipulum of *Encoelia nicaraguensis*; x 280, from holotype.
Fig. 26. Transverse section of apothecial margin of *Encoelia urceolata*; x 280, from holotype.
Fig. 27. Transverse section of excipulum at flank of *Encoelia urceolata*, x 280, from holotype.
Fig. 28. An ascus, an ascospore, and a paraphysis apex of *Ionomidotis australis*, x 1000, from holotype.
Fig. 29. An ascus, an ascospore, and paraphysis apices of *Ionomidotis chilensis*; x 1000, from holotype.
Fig. 30. An ascus, an ascospore, and paraphysis apices of *Ionomidotis frondosa*; x 1000, from neotype.
Fig. 31. An ascus, an ascospore, and a paraphysis apex of *Ionomidotis fulvotingens*; x 1000, from holotype.
Fig. 32. An ascus, an ascospore, and a paraphysis apex of *Ionomidotis irregularis*; x 1000, from holotype.
Fig. 33. An ascus, an ascospore, and paraphysis apices of *Ionomidotis olivascens*; x 1000, from holotype.
Fig. 34. An ascus, an ascospore, and a paraphysis apex of *Ionomidotis portoricensis*; x 1000, from holotype.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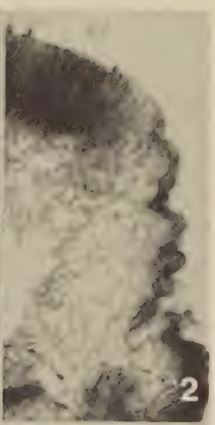
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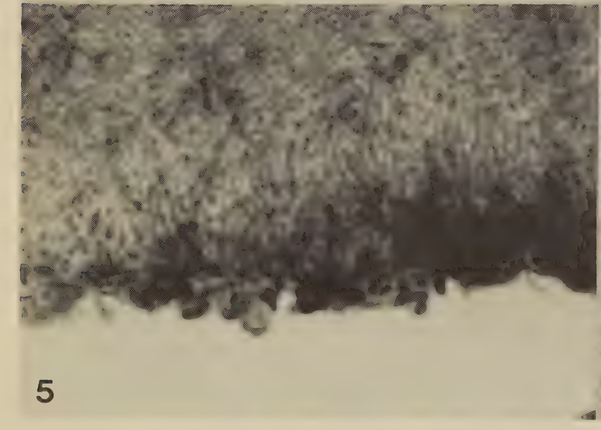
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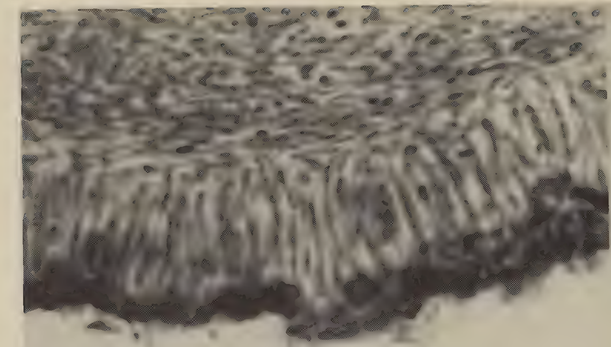
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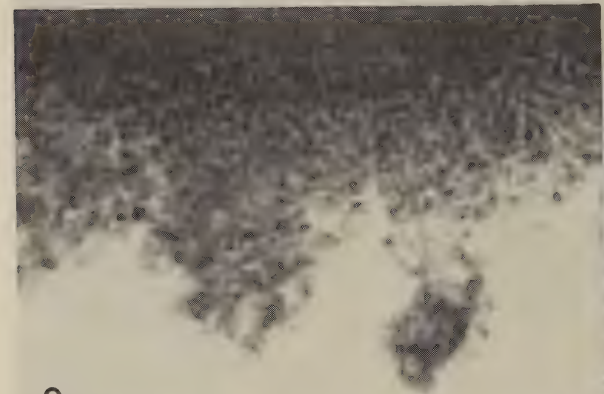
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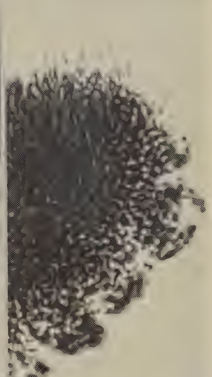
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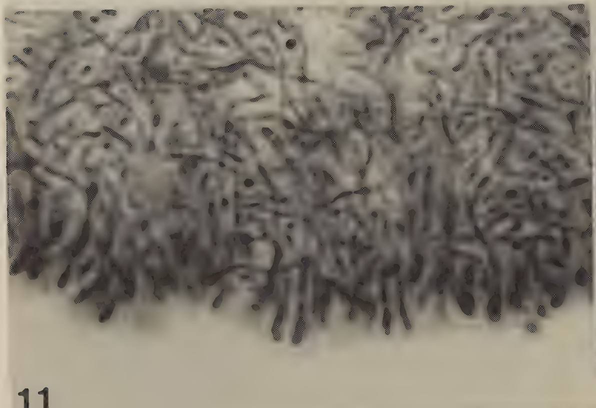
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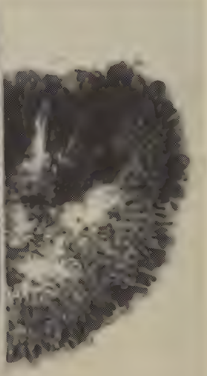
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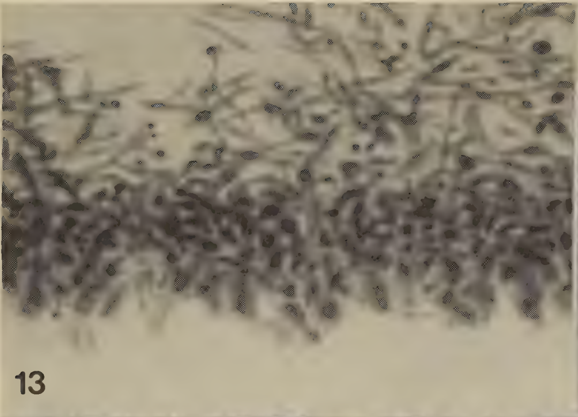
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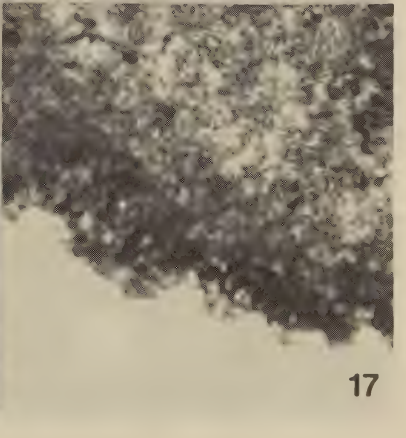
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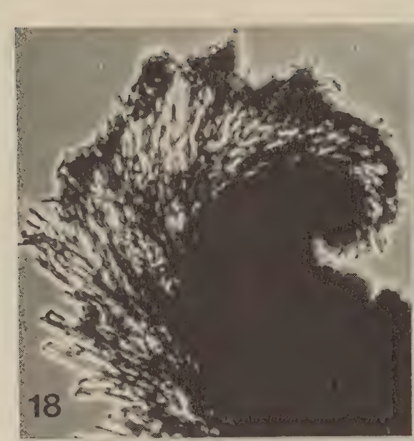

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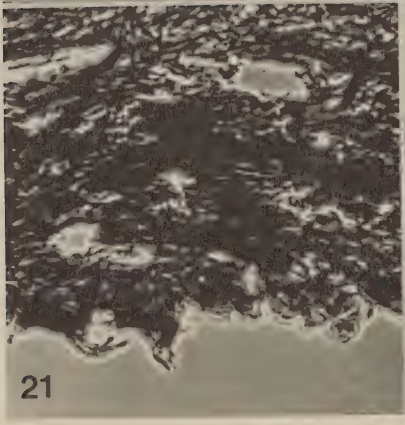

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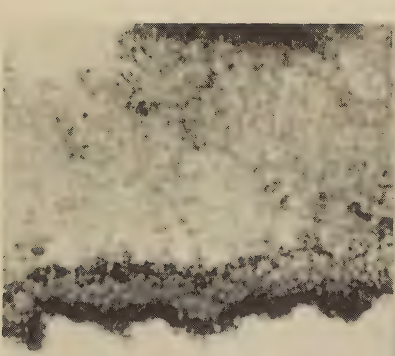

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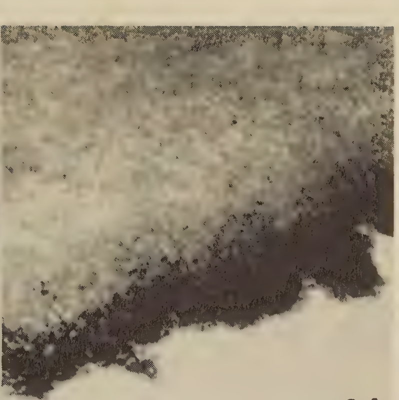

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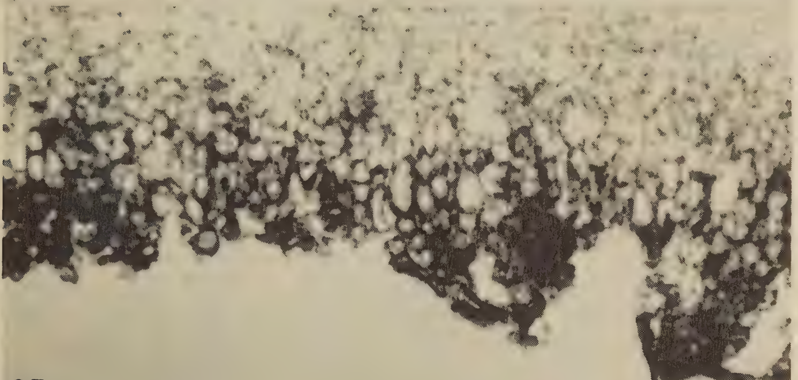

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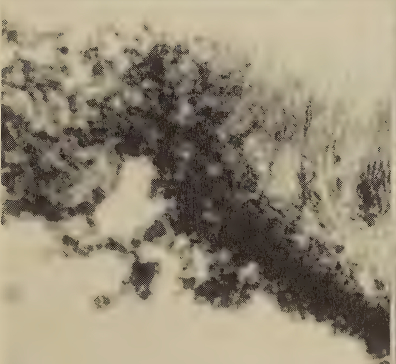

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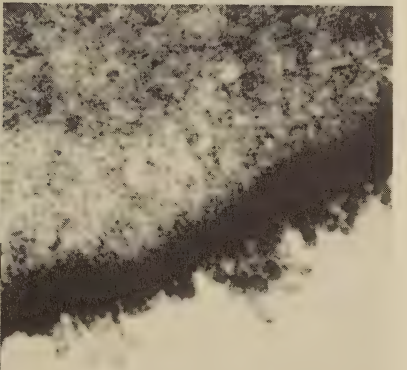

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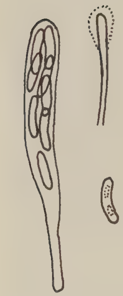

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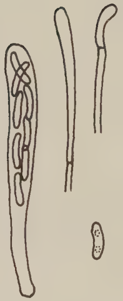

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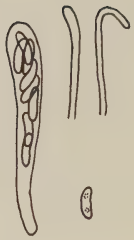

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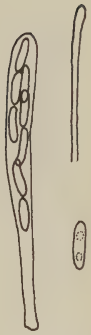

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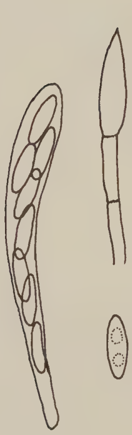

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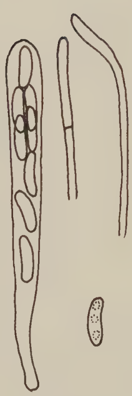

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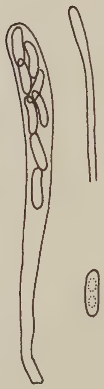

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MYCOTAXON

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TWO NEW SPECIES OF CORTICOLOUS *MYXOMYCETES* FROM SPAIN

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Summary

Two new species of *Myxomycetes* are described from Central Spain which developed on *Juniperus thurifera* L. bark in moist chamber cultures. *Licea nannengae* sp. nov. can be distinguished from other *Licea* species by its double peridium with a membranous, smooth and conspicuous inner iayer and smooth, olivaceous spores and *Macbrideola oblonga* sp. nov. which most closely resembles *M. ovoidea* Nann.-Brem. & Y. Yamam., but differs from it in its larger, densely and minutely-warted spores and the shorter stalk.

Licea nannengae Pando & Lado sp. nov. subgenus **Licea**

Species *Liceae kelleri* Nann.-Brem. & Y. Yamam. proxima, sed ad ea peridio cristato, substrato peridiali patenti, membranoso, atque sporis maioribus (9.5-13.5 µm diam.) primo ictu discernibilis; a specie autem *Licea denudescenti* Keller & Brooks facile nostra discernetur cum peridium omni ornatu in latere interno careat cumque stratum eius externus tenuis revera et non fugax sit.

Sporangia scattered to gregarious, 0.05-0.20 mm diam., sessile, nearly globose on a somewhat narrowed to broad base, without dehiscent platelets but with little ridges when dry. Hypothallus not observed. Peridium dark brown to yellow-ochraceous, with deposits of granular refuse material, which, when they are scanty allow observation of the membranous inner layer, which is translucent, shiny, somewhat iridescent; in transmitted light, smooth, pale-olive coloured. Dehiscence takes place along the ridges (into platelets and lobes, leaving a cup with a glossy base), although, in transmitted light, such ridges in closed sporangia are not marked. Spores smooth, globose, dark-brown in reflected ligth, in transmitted, olivaceous-brown with a pale area, 9.5-13.5 µm diam., spore wall thick with a thinner area. Plasmodium not observed.

Collections examined. Burgos: Carazo, 1200 m, 30TVM7047, bark of *Juniperus thurifera* in moist chamber, 21-III-1986, *C. Lado, F. Pando & J. Portela,* 228 Pando, MA-Fungi 16038.

Guadalajara: Anchuela del Campo, near 4 km of the road to Labros, 1150 m, 30TWL8343, bark of *Juniperus thurifera* in moist chamber, 17-XII-1984, *J. Checa, C. Lado & F. Pando,* 115 Pando, MA-Fungi 15924. Huertahernando, bridge on Salinas river, 940 m, 30TWL5922, bark of *Juniperus thurifera* in moist

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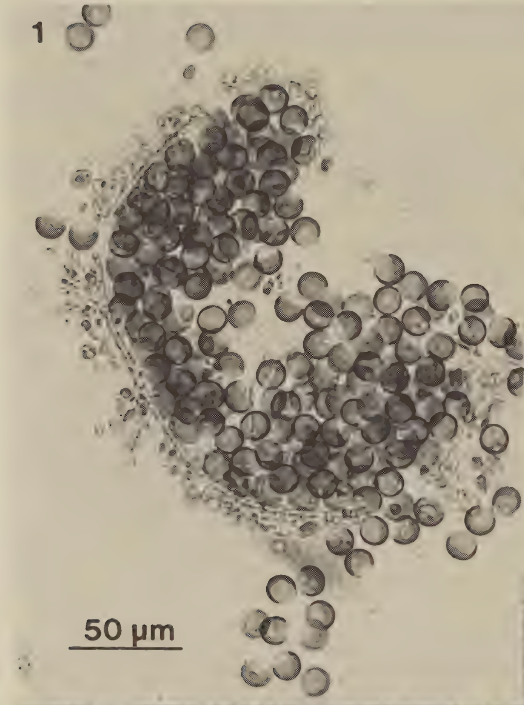

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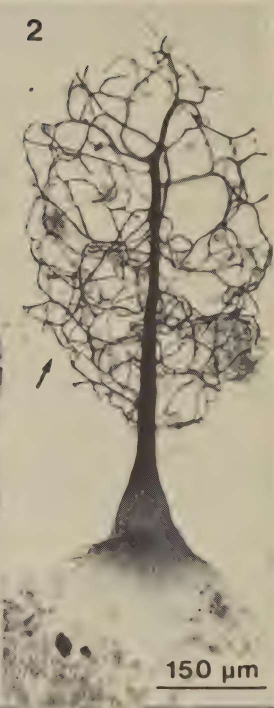

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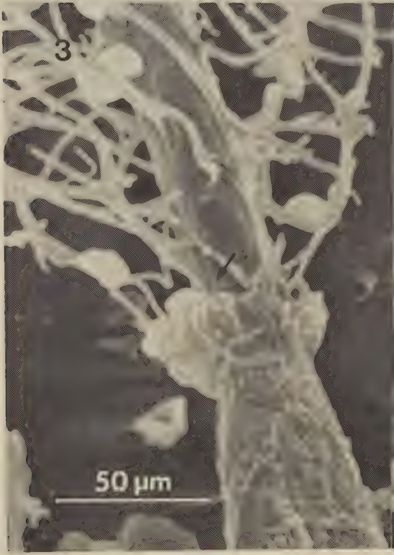

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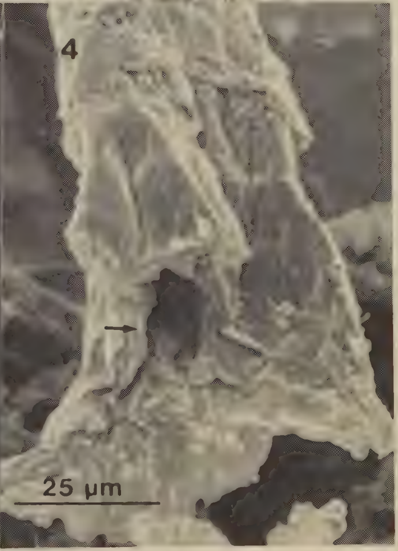

chamber, 23-X-1984, *C. Lado,* 83 Pando, MA-Fungi 15892; ibidem, 13-XI-1984, 85 Pando, MA-Fungi 15894; ibidem, 21-XI-1984, 86 Pando, MA-Fungi 15895; ibidem, 31-X-1984, 95 Pando, MA-Fungi 15904; ibidem, 21-XI-1984, 96 Pando, MA-Fungi 15905; ibidem, 21-XII-1984, 97 Pando, MA-Fungi 15906; ibidem, 31-X-1984, 99 Pando, MA-Fungi 15908. Santiuste, 1000 m, 30TWL1649, bark of *Juniperus thurifera* in moist chamber, 20-III-1986, *J. Checa, C. Lado & F. Pando,* 224 Pando, MA-Fungi 16034. Tamajón, Virgen del Enebral, 1040 m, 30TVL7941, bark of *Juniperus thurifera* in moist chamber, 28-II-1986, *F. Pando,* 205 Pando, MA-Fungi 16015; ibidem, 17-II-1986, 206 Pando, MA-Fungi 16016. Torremocha del Pinar, 1250 m, 30TWL8027, bark of *Juniperus thurifera* in moist chamber, 30-X-1984, *A. Mendoza & F. Pando,* 111 Pando, MA-Fungi 15920.

SEGOVIA: Prádena, 1200 m, 30TVL4555, bark of *Juniperus thurifera* in moist chamber, 20-II-1986, *J. Checa, C. Lado & F. Pando,* 209 Pando, MA-Fungi 16019; ibidem, 28-II-1986, 211 Pando, MA-Fungi 16021. Siguero, 1080 m, 30TVL4959, bark of *Juniperus thurifera* in moist chamber, 24-II-1986, *J. Checa, C. Lado & F. Pando,* 216 Pando, MA-Fungi 16026.

SORIA: Cubillos, 1080 m, 30TWM0421, bark of *Juniperus thurifera* in moist chamber, 1-IV-1986, *C. Lado, F. Pando & J. Portela,* 236 Pando, MA-Fungi 16046; ibidem, 26-III-1986, 246 Pando, MA-Fungi 16056. Valdenebro, 950 m, 30TWM0403, bark of *Juniperus thurifera* in moist chamber, 13-III-1986, *F. Pando,* 225 Pando, MA-Fungi 16035.

Type locality. SORIA: Cubillos, 1080 m, 30TWM0421.

Type. 246 Pando, MA-Fungi 16056 (Holotype); bark of *Juniperus thurifera* in moist chamber. Paratype in the herbarium of N. E. Nannenga-Bremekamp sub. no. 15244.

Habitat. Bark of living trees *(Juniperus thurifera).*

Distribution. Central Spain.

Etymology. In honor of Mrs. N. E. Nannenga-Bremekamp, a master in the study of the Myxomycetes.

The sporangia often begin to appear soon in moist chamber on suitable substrata, but they may take rather a long time to mature, the incubation time has varied from 9 days to more than a month, with a maximum of gatherings around the 25th day. This species was frequent in our cultures, forming widely-spread fructifications.

This species is rather like *L. kellerii* Nann.-Brem. & Y. Yamam. (NANNENGA-BREMEKAMP & YAMAMOTO, 1983) from which it differs in the ridged sporangia, the conspicuous, membranous inner layer of the peridium and larger spores (fig. 1). It can be readly distinguished from *L. denudescens* Keller & Brooks (KELLER & BROOKS, 1977) which may also resemble it by its smooth inner surface of the peridium without any eroding outer layer.

With respect to other related specimens, Mr. Stephenson collected a *Licea* in the USA which seems to be closely related to *L. nannengae,* but has a wrinkled peridium, and slightly larger spores (13-14 µm diam.) (NANNENGA-BREMEKAMP,

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Fig. 1.—*Licea nannengae.* Single sporangium with spores as seen in transmitted light.

Figs. 2-4.—*Macbrideola oblonga.* 2. Sporangium. 3. SEM showing a sporangium with the peridial collar. 4. SEM showing the base of a stalk with hollow inside and the absence of fibers.

in litt.). There is a taxon from India *(Licea mercurialis* Chopra, unpublished data), which also has spores 13-14 µm diam. and differs from ours in the smooth peridium exterior, and the peridium having a very thin gelatinous outer layer with only a little dirt (NANNENGA-BREMEKAMP, *in litt.).* From *Licea belmontiana* Nann.-Brem. (NANNENGA-BREMEKAMP, 1966) which is very like in the interna smooth inner surface of the peridium and smooth spores, it differs in the double peridium, the outer layer being gelatinous and containing refuse material, and in the colour of the spores which is pinkish brown or brown (not olivaceous) in *L. belmontiana.*

Macbrideola oblonga Pando & Lado sp. nov.

Species *Macbrideolae ovoideae* Nann.-Brem. & Y. Yamam. proxima, sed ab ea sporis maioribus [(9-)10-11 µm diam.] atque densis verruculis ornatis, sporangiis itidem maioribus (0.4-0.9 mm) stipitibusque proportionaliter brevioribus primo icto discernibilis.

Sporangia scattered, sometimes in pairs, stipitate, mostly ellipsoidal (fig. 2), rarely from subglobose to cylindrical, burnt umber (Rainer: 9 Umber) total height 0.4-0.9 mm. Sporangium proper 0.20-0.45 mm in its largest horizontal diam. Hypothallus wide, reddish in reflected light. Stalk conical almost to the apex, short (1/6-1/4 of the total height), reddish, translucent at the base, opaque upwards, indistinctly longitudinally striate, sometimes filled with rather inconspicuous, almost translucent, irregular lumps (fig. 4). Peridium evanescent except for a collar (fig. 3), which is transparent, red-brown, large or small and inconspicuous. Columella a continuation of the stalk almost reaching the apex of the sporangium. Capillitium rising from all parts of the columella, dichotomously branched, ending free of united near the surface, hardly or not anastomosing inside, rather thick, brown, hardly attenuate outwards, free ends blunt, slightly swollen or club shaped. Spores globose, brown in mass, pale brown in transmitted ligth, (9-)10-11 µm in diam. densely regular and minutely warted.

Collections examined. SORIA: Calatañazor, Dehesa de Carrillo, 1050 m, 30TWM1417, bark of *Juniperus thurifera* in moist chamber, 7-III-1986, *C. Lado, F. Pando & J. Portela,* 198 Pando, MA-Fungi 16008; ibidem, 14-III-1986, 199 Pando, MA-Fungi 16009.

Type locality. SORIA: Calatañazor, Dehesa de Carrillo, 1050 m, 30TWM1417.

Type. 198 Pando, MA-Fungi 16008 (Holotype); bark of *Juniperus thurifera* in moist chamber. Isotype in the herbarium of N. E. Nannenga-Bremekamp sub. no. 15208.

Habitat. Bark of living trees *(Juniperus thurifera).*

Distribution. Only known from the type locality.

Etymology. From the Latin oblongus, oblong.

The absence of a capillitial surface net, the hollow stalk and lack of fibers together with the small size and the ovoid shape of the sporangia have led to us to incorporate this taxon in *Macbrideola.* Nevertheless, the prolate shape means a slight approach to *Stemonaria* (NANNENGA-BREMEKAMP, *& al.*, 1984), a very closely related genus for larger species with cylindrical sporangia with a hollow, homogeneous, or indistictly longitudinally fibrous or striate stalk and lacking a capillitial surface net.

M. oblonga resembles *M. ovoidea* Nann.-Brem. & Y. Yamam. (NANNENGA-BREMEKAMP & YAMAMOTO, 1983) in the oval shape of but it differs in its larger, densely and minutely warted spores. Moreover, it is taller (0.4-0.9 mm vs. 0.5 mm), with shorter stalks (circa 1/4 or less of the total height vs. 1/2), wide hypothallus and capillitium frequently anastomosing at the periphery.

ACKNOWLEDGMENTS

We are greatly indebted to Mrs. N. E. Nannenga-Bremekamp for her advice and coments on both species and reading the manuscript. We wish to thank to Dr. M. Laínz, S. J. for his Latin translations and Ms. R. N. Longshaw for kindly checking the English.

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PHYTOPHTHORA FRAGARIAE

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Abstract

Since its first description by Hickman in 1940, the species concept of Phytophthora fragariae has been clouded by controversies in literature concerning its antheridial type, sporangial size and other cultural characteristics. Present study was undertaken to compare 21 isolates of P. fragariae from various parts of the world in order to re-define the species based on morphological, cultural and physiological characteristics.

Introduction

Phytophthora fragariae was erected in 1940 by Hickman (38) for the fungus causing a root disease of strawberries in the United Kingdom, known as the red core due to the characteristic coloration of the stele (1-3,5,6,37). Since its discovery, the disease has been a hazard of commercial strawberry production in many parts of the world, including the USA, Canada, Ireland, New Zealand and Australia (63), Japan (53,67), Egypt (68), Russia (72), Italy (8), Czechoslovakia (9), Sweden (34), Germany (54) and other European countries (63).

Hickman (38) considered P. fragariae distinct from other species of Phytophthora based primarily on its slow growth, inability to grow on malt extract agar medium, preference for low temperature, production of large, obpyriform sporangia in water and fairly large, smooth, globose oogonia with funnel-shaped base and predominantly amphigynous antheridia in single culture as well as pathogenicity limited to cultivated strawberries. However, later researchers claimed that P. fragariae grew on malt (30,50) while Chang (10) reported a high temperature variant of P. fragariae with an optimum temperature of 25-35 C. There was considerable confusion regarding the antheridial type of P. fragariae. Whereas Waterhouse (82) placed it in

Group V with predominantly or entirely paragynous antheridia, Savage *et al*., (75) reported that the antheridia of *P. fragariae* were all amphigynous. Besides strawberry, *P. fragariae* infected loganberry in Canada (59) and by artificial inoculation, members of Rosaceae, e.g., certain species of *Potentilla*, *Geum*, *Dryas* and *Rubus* (16,66,73) as well as tobacco, tomato and spinach (4). Recently, Wang and Lu (81) reported a new variety of *P. fragariae* on rice: *P. fragariae* var. *oryzo-bladis*, distinguished by its entirely amphigynous antheridia and pathogenicity to rice. It seems that in view of the conflicting reports, the biology of *P. fragariae* needs to be re-examined to assure proper identification of the species. The purpose of this paper is to compare the characteristics of a wide variety of isolates of *P. fragariae* under uniform laboratory conditions in order to define the species more precisely.

Materials and Methods

Isolates and media: Specific information on the isolates of *P. fragariae* used is given in Table 1. All isolates were obtained from the American Type Culture Collection (ATCC), Rockville, Maryland. Unfortunately, Hickman (38) never designated a specific isolate as the type culture but ATCC 58229 which was initially isolated by Hickman (No. 27) from Cambridge seedling in England (39) and brought with him when he moved to the University of Western Ontario, Canada (P18-1-2) can be considered the "type culture". Unless otherwise stated, cleared V-8 agar (74) supplemented with sitosterol (30 mg/l) was used throughout for morphological studies.

Morphology: Colony characteristics on CV8 and Difco corn meal agar (CMA) were compared after incubating in darkness at 20 C for 3 wk. The colony diameters were measured at right angle through the inoculum and the width of primary hyphae measured under light microscope. The minimal and maximal temperatures for growth were tested at 5 C and 30 C. Sporangia were produced by incubating small mycelial agar discs of CV8 in freshly collected running stream water sterilized by filtration through 0.45 µm pore size millipore membrane discs and incubating under light at 20 C. Production of sex organs in single cultures in dark was followed on CV8 by examining them periodically under microscope through the bottom of the petri dish. After the agar dried out and if no oogonia could be observed in the plate, the inoculum was cut out with a scalpel, boiled in distilled water to soften and remove the agar and then stained and mounted on glass slides for further examination for sex organs. Isolates were also paired among themselves and with both mating types of *P. nicotianae* (ATCC 38606, A2; ATCC 38607, A1 and *P. palmivora* (ATCC 26200, A2; ATCC 26201, A1).

Ability to grow on malt extract agar: Isolates were grown

Table 1. Isolates of *Phytophthora fragariae* Used

ATCC	Host	Origin	Source
11107	Strawberry	Scotland	Hickman, R-4
11109	Strawberry	Scotland	Hickman, R-13
11110	Strawberry	New Zealand	Hickman, N2
11374	Strawberry	USA	Jeffers, S
13973	Strawberry	USA	Converse, BD C-3, C3,SS-1
13974	Strawberry	USA	Converse, 104a, SS-1
13977	Strawberry	USA	Converse, ATCC 11374, SS-1
16678	Strawberry	USA	Converse, H2FSC
18638	Strawberry	USA	Converse, Calif 6-2
36056	Strawberry	England	Montgomerie, 152
36057	Strawberry	England	Montgomerie, 144
44567	Strawberry	England	Montgomerie, 120
46092	Loganberry	Canada	Montgomerie, 169
46094	Strawberry	Canada	Montgomerie, M2
46095	Strawberry	Canada	Montgomerie, M3
46096	Strawberry	Canada	Montgomerie, M4
46097	Strawberry	Canada	Montgomerie, M7
46447	Strawberry	Canada	Montgomerie, 172
58229"T"	Strawberry	England	Hickman, P18.1.2
62265	Strawberry	Scotland	Duncan, 314
62267	Strawberry	Scotland	Duncan, 452

ATCC - Identified by American Type Culture Collection Accession Number
"T" - Type Culture

on 4.5% Difco malt extract solidified with 1.5% Bacto agar. Colony diameters were measured after 3 wks.

Ability to grow on PDA agar: Isolates were grown on Difco potato agar medium. Colony diameters were measured after 3 wks.

Pigment production: Isolates were grown on Timmer's medium (74) in test tubes. Production of pigment in the medium was determined after 4 wks at 20 C in the dark.

Growth response to malachite green: Malachite green was added to CMA at a concentration of 1:18,000,000. Colony diameters were measured after 3 wks.

Ability to utilize nitrate nitrogen: Isolates were grown on Ribeiro's synthetic agar medium (74) minus asparagine so that nitrate nitrogen was the only nitrogen source. Colony diameter was determined after 3 wks.

Ability to utilize soluble starch: Isolates were grown on starch agar medium (46). At the end of 3 wk, the colony diameters were measured and 3% iodine solution was poured over the colony and the starch hydrolysis index determined as described by Ho and Foster (46).

Pathogenicity to apple: Apple fruit (McIntosh) was inoculated through artificial wound which was then sealed with Scotch tape and enclosed in a plastic bag. Results were determined after incubation at 20 C for 3 wks.

For physiological and pathological tests, not all isolates were used. At least five isolates were selected at random for each test.

Results

Colony morphology: All isolates of P. fragariae were characterized by slow growth rate on CV8 (<1-3 mm/day) with thick and fluffy aerial mycelium. The edge of the colony was slightly irregular and diffuse. The leading hyphae were uniform (5-7 μm wide), long and meandering, with few but elongated branches which intertwined and curved, especially near the bottom or along the side of the dish. While the extent of coiling varied with the isolate, it was most conspicuous in ATCC 13974 and ATCC 62267 which showed hyphal coilings comparable to those usually found in P. porri and P. primulae (44). Isolate ATCC 36057 was exceptional in having irregular, spidery hyphae with short lateral branches while ATCC 11110 showed signs of degeneration with the hyphal tips often bursting. Although the colony displayed no special growth pattern, a characteristic light brown pigmentation often developed near the center on the bottom of the CV8 plate after prolonged incubation. Isolates of P. fragariae grew slightly faster on CMA with appressed web-like colonies and little aerial mycelium and the reverse pigmentation as seen commonly in CV8 never developed. All isolates showed very slight growth at 5 C and no growth at 30 C.

With time, the uniform hyphae occasionally became uneven, developing small swellings (under 25 μm diam), oval, spherical or irregular, randomly spaced along the hyphae or at the junction where branching occurred. They were especially common in isolates ATCC 11109, ATCC 46096 and ATCC 62265.

Sporangia: Sporangia were produced readily in water by all isolates within 24-48 hr except ATCC 11107, ATCC 13973 and ATCC 18638 which did not sporulate until 3-5 days later, whereas, it took ATCC 46097 7 days to produce sporangia sparsely. In general, nonsterile stream water proved to be considerably more stimulatory than sterilized stream water. The sporangia were non-deciduous, nonpapillate and internally proliferation, especially the "nested" type was common. Usually, there was considerable hyphal growth into the water before sporangia were produced singly and terminally on an undifferentiated sporangiophore which sometimes branched sympodially to bear sporangia on short branches. The sporangia were mostly large, regularly obpyriform, ovoid to elongate, with rounded base and sometimes tapering slightly to a blunt beak. The apex of sporangia did not flatten easily on mounting, but the empty sporangia collapsed partially after zoospores were liberated. The measurements of sporangia for all isolates are summarized in Table 2.

After about a week in water, the hyphae sometimes developed small hyphal swellings similar to those found in old agar plates, but chlamydospores were not formed.

Sex organs: Despite numerous attempts to stimulate the production of sex organs in *P. fragariae*, they were formed only sparsely either in water after sporangial production or in old CV8 cultures which were about to dry out or in desiccated inoculum discs. The oogonia were often aborted and if produced in agar were sometimes so tightly wrapped by hyphae that it was difficult to separate them. Pairing with A1 and A2 mating types of other heterothallic species of *Phytophthora* failed to improve the production. The oogonium was rather large, globose to subglobose or even ellipsoidal, often with a conspicuous tapered base so that the single spherical oospore appeared to be aplerotic to markedly aplerotic within the flask-shaped oogonial wall. In general, the oogonia developed in agar cultures were deeply pigmented in contrast to the non-pigmented oogonia in water. The antheridium was unicellular, rather large and mostly amphigynous, sometimes subterminal so that the antheridium appeared to bear an appendage or papilla. Distinct paragynous antheridia were found, usually attached singly to the tapered base of the oogonium. In isolate ATCC 13973, the antheridial type was difficult to

Table 2. **Sporangial characteristics and morphology of sex organs of *Phytophthora fragariae***

ATCC	Sporangia			Oogonium	Oospore	Antheridia		
	Length(μm)	Breadth(μm)	L/B	diam (μm)	diam (μm)	Type(b)	Length(μm)	Width(μm)
11107	68±12 (a)	32±7	2.1±0.3					
11109	52±8	30±2	1.7±0.2	39±3(c)	30±3(c)	A*/P	18±1(c)	13±1(c)
11110	48±14 (c)	22±7(c)	2.2±0.6 (c)					
11374	87±22	38±5	2.3±0.6	40±3	34±3	A*/P	19±1	17±3
13973	62±11	31±5	2.0±0.3	34±3	28±3	A/P	14±3	14±2
13974	57±11	45±15	1.7±0.1	44±2(c)	37±3(c)	A*/P	17±2(c)	15±2(c)
13977	73±16	33±6	2.2±0.3	45±5	38±6	A*/P	22±4	17±3
16678	50±7	29±4	1.7±0.2	39±3(c)	32±4(c)	A*/P	16±3(c)	15±2(c)
18638	59±7	34±4	1.8±0.2	38±5(c)	29±3(c)	A/P	16±3(c)	12±2(c)
36056	59±8	35±5	1.7±0.2	36±3	29±3	A*/P	15±2	15±2
36057	62±9	37±4	1.7±0.1					
44567	48±8	23±5	2.1±0.2					
46092	72±9	56±17	1.7±0.3					
46094	74±12	40±5	1.8±0.1					
46095	47±6	29±3	1.6±0.2					
46096	43±9	29±6	1.6±0.3	38±2(c)	32±2(c)	A*/P	16±3(c)	16±2(c)
46097	71±8 (c)	31±4(c)	2.1±0.2(c)	40±3	34±3	A*/P	22±4	18±2
46447	48±7	28±4	1.7±0.3					
58229	46±7	28±7	1.9±0.2	41±4	35±4	A*/P	15±1	13±2
62265	44±4	31±3	1.4±0.1					
62267	60±5	32±5	1.9±0.2	34±3(c)	28±3(c)	A/P	13±2(c)	11±2(c)

(a) Mean ± standard error based on 50 measurements

(b) A= Amphigynous, P= Paragynous, *= Dominant type

(c) Less than 50 measurements due to paucity of distinct reproductive structures distinguish due to the abundance of antheridial papillae as in P. richardiae (Ho, unpublished). In ATCC 62267, most of the oogonia were ellipsoidal and the antheridia were sometimes absent. The dimensions of the sex organs and the antheridial types for all isolates are summarized in Table 2.

Although chlamydospore-like structures (20-39 μm diam) were sometimes observed in old cultures, for example in ATCC 11109 and ATCC 13977, they had only a single wall and lacked the reorganization of cell contents characteristic of chlamydospore. With time, these structures become brown like mature oogonia, and so they were interpreted as unfertilized oogonia which aborted due to absence of antheridia.

Physiology: All isolates tested were quite uniform in their response. Thus, they produced very slight pigmentation in Timmer's medium, showed no or very poor growth on malt extract, PDA, nitrate, starch or malachite green agar medium. They caused no or very slight lesions on apple fruit.

Discussion

Since its first discovery, Phytophthora fragariae has been the major factor limiting the production of strawberries in many parts of the world and consequently, most studies centered on its isolation (27,84), inoculum production (11,23,57,70,85), physiological races (12-14,17,29,31,32,39,60,64,65,78), pathogenicity and disease development (26,33,41-43), resistance and disease control (18,51,52,55,69) as well as ecology (20-22,25). Little work was done on taxonomy and morphology of the species except for the zoospore characteristics (47,61). For the sake of discussion, the published data on P. fragariae are summarized in Table 3.

As noted by Hickman (38) and other workers(5,54,56, 68) P. fragariae is characterized by slow growth (1.2 - 6.5 mm per day). We found that P. fragariae isolates grew very slowly on clarified V-8 juice agar medium (<1-3 mm per day) and in addition, produced thick and fluffy aerial mycelia and, with time, light brown coloration of the reverse. Although Maas (56) reported some isolates growing at 30 C, none of the isolates tested here grew at this temperature, thus confirming the experience of previous workers (Table 3) that the maximum temperature for this species should be 30 C or 25-30 C. Krober (54) is the lone exception in listing the maximum temperature for P. fragariae as 25 C. In any case, P. fragariae can be classified as a low-temperature Phytophthora (44). Phytophthora fragariae isolates grew at 5 C, though extremely slowly.

There were conflicting reports on the ability of P. fragariae to grow on malt extract agar medium. Hickman

Table 3. Characteristics of Phytophthora fragariae recorded in literature

Author	Year	Temperature			Sporangium			Oogonium	Oospore	Antheridium		
		Min.	Opt.	Max.	Length (μm)	Breadth (μm)	L/B	diam. (μm)	diam. (μm)	Type (a)	Length (μm)	Width (μm)
Alcock	1929				50	30	1.7	46-47	33-47	A		
Alcock et al.	1930				50			44	33	A/P		
Alcock & Howell	1936									A/P		
Bain & Demaree	1938			30	Large			Large		A*/P		
Hickman	1940	5	20	30	60	38	1.6	39	33	A*/P	134	16
Bain & Demaree	1945	5	22	30	65	38	1.7	39	33.5	A/P*		
Smith	1951				49	31	1.6	32	30	A		
Waterhouse & Blackwell	1954				60	38	1.6	39	33	A*/P	22	16
Gregg	1955							33-83	23-60			
								28-42	20-35			
McKeen	1958	5		30	55	3	1.5	41	33	A*/P		
Schwinn	1959	5	10-15	30								
Cejp	1961				32-90	25-50		25-40	23-35	A*/P	15-30	10-25
Converse & Shiroishi	1962								30	A*/P		
Waterhouse	1963				60	38	1.6		40	A/P*		
Morita	1965		22	30	59.7	32.8	1.8	36	31.6	A*/P	22	16.3
Savage et al.	1968							35	32	A		
								45	34			
Katsura	1971	5	22	30	58.7	32.8	1.8	36	31.6	A*/P	22	16.3
Maas	1972	5		30								
				30								
Novotelnova	1974	4	20	30	60	38	1.6	39	33	A*/P	22	16
Newhook et al.	1978				often 75		1.6	28-50	25-40	A*/P		often 20
Ribeiro	1978	5	20-22	30	32-90	22-52		28-44	22-44	A/P	22	16

Table 3. (continued)

Author	Year	Temperature			Sporangium			Oogonium	Oospore	Antheridium		
		Min.	Opt.	Max.	Length (µm)	Breadth (µm)	L/B	diam. (µm)	diam. (µm)	Type (a)	Length (µm)	Width (µm)
Krober	1985	5		25	60	34	1.8	44	35	A*/P		
Gerrettson-Cornell	1985				57	36	1.6			A*/P		
Moustafa	1986	8	20-24	28								

A = Amphigynous; P = Paragynous; *= Dominant Type

(38) reported that the fungus did not grow on 2% malt extract agar and this was considered an important taxonomic character. This feature was confirmed by Bain and Demaree (6) and Moustafa (68), but challenged by Jarvis (50) who reported good growth on agar medium with 1% Difco malt extract. Gill and Powell (30) found some growth on 0.5% malt extract agar but not on Difco malt extract agar medium which contained 1.275% maltose and 0.275% glucose. In our study, we found none of the isolates of P. fragariae was able to grow on 4.5% malt extract agar medium. It is possible that the discrepancies in results could be attributable to the differences in the concentration of malt extract used. Phytophthora fragariae was completely inhibited in a medium containing 2% reducing sugars like dextrose or maltose which might react with glycine to produce toxins (58). Thus, we found that P. fragariae isolates had no or very poor growth on Difco potato dextrose agar medium which contains 2% glucose. It is likely that in higher concentration of malt extract there is enough toxins produced to inhibit the growth. Ho (unpublished) noted that isolates of P. fragariae which failed to grow on 4.5% malt extract agar, grew well when the malt extract was reduced to 0.5%. The inability of P. fragariae to grow on agar medium containing 2% or more malt extract readily distinguishes it from other species with similar morphological characteristics. Further, it has no or very poor growth on corn meal agar medium incorporated with malachite green. In this respect, it is similar to other Phytophthora species with low maximal growth temperatures, for example P. porri, P. syringae and P. hibernalis which proved to be highly sensitive to malachite green (44).

Unlike most species of Phytophthora, P. fragariae is fastidious in its nutritional requirements (48). Present study has confirmed earlier observations (19, 46) that this species has no or very limited ability to utilize soluble starch, and that it has absolute requirement for organic nitrogen (24,48) which cannot be replaced by inorganic nitrate.

Present study has also clarified various aspects of the morphology of Phytophthora fragariae. As reported by Hickman (38) and McKeen (59), the main hyphae measured about 6 μm wide, smooth to slightly irregular and meandering with frequent coiling, a feature commonly found in P. porri and P. primulae (44). Although Newhook et al., (71) did not list hyphal swellings for P. fragariae, some isolates in our study produced small hyphal swellings under 20 μm in water or in old cultures. They were spherical, oval, elongated or irregular, unevenly spaced along the hyphae or at the junction where branching occurred. Hyphal coiling and swellings of similar size were diagrammed by Hickman in his original description (38).

Most isolates of P. fragariae in our study produced rather large sporangia, some attaining over 100 μm in length. The overall mean sporangial length of all isolates was 59 ± 12 μm comparing well with the published data in literature (49-65 μm). The sporangium of this species has been described as large, up to 90 μm or often over 75 μm long (38,71,82). In shape, the sporangium was regularly obpyriform, mostly with rounded base and often elongated, with the distal portion narrowing slightly to a blunt beak. The nonpapillate apex did not flat out easily on mounting as commonly encountered in P. cryptogea, P. drechsleri and P. erythroseptica (71), and unlike these species, sympodial branching of the sporangiophore was not as common. The overall mean of the length/breadth ratio of sporangia was 1.8 ± 0.2 matching closely the overall mean in literature (1.5 - 1.8). The slightly lower L/B ratio in literature could possibly be due to the fact that sporangia were produced mostly in darkness because light usually stimulates the production of longer sporangia (36). As observed previously by many workers, internal proliferation of sporangia was common in most isolates of P. fragariae. It is perplexing that this important character was not listed for this species in the tabular key of Newhook et al. (71).

Although P. fragariae produced sex organs readily in strawberry roots, it either failed to produce or produced them only sparsely in cultures (6,15,38,75). We have experienced the same difficulty too, in our study. Gregg (35) reported that oospore production of P. fragariae was induced by a contact stimulus of artificial membranes, but we were unsuccessful in enhancing the ability of this species to form oospores by means of cellophane or millipore membranes. It is possible that the membrane served as the site for the absorption of active principle(s) and thus in turn, allowed sex organs to be formed in its vicinity. Nevertheless, since there was no indication that mating types existed in P. fragariae, we concurred with Savage et al. (75) that it should be classified as homothallic until the factors governing sexual reproduction in P. fragariae can be worked out in the future.

As often reported in literature (1,6,20,38,67,75,77), the oogonium of P. fragariae typically had a tapered base similar to that of P. cambivora (44) but differed in having a smooth oogonial wall instead. The overall mean of oogonial diameters of all isolates of P. fragariae in present study was 39 ± 3 μm, in close agreement with the published data (35-47 μm). The oospore was aplerotic to markedly aperotic, measuring 32 ± 3 μm, comparing well with the dimensions reported in literature (30-40 μm). However, the antheridial type of P. fragariae is highly controversial. Alcock et al. (3) and Alcock and Howells (2) reported amphigynous and paragynous antheridia in equal proportion whereas Hickman (38), McKeen (59), Converse and Shiroshi (15), Morita (67), Katsura (53), Krober (54) and Gerrettson-Cornell (28) described the antheridia of P. fragariae as predominantly amphigynous. Bain and Demaree (5) initially considered the antheridia to be predominantly amphigynous but later (6) questioned the existence of truly amphigynous type. Waterhouse (82) placed this species in Group 5, characterized by antheridia being completely or predominantly paragynous. Yet, Waterhouse and Blackwell (83) described P. fragariae on the British Isles as predominantly amphigynous. Newhook et al. (71) designated the antheridia of P. fragariae in their tabular key as amphigynous and occasionally paragynous. On the other hand, some researchers found only amphigynous antheridia (1,75,77). The nature of antheridial configuration is especially important because along with the sporangial papillation, it forms the basis for the grouping of Phytophthora species (71,82) and is considered as the most important and most reliable taxonomic character (45,79). Thus, Wang and Lu (81) created a new variety of P. fragariae partially based on its entirely amphigynous antheridia. Our study showed that of those isolates that produced sexually in culture, the antheridia were mostly amphigynous although paragynous types were also present. Thus P. fragariae should not be included in Waterhouse's Group V and to avoid confusion, it is better to merge Group V and Group VI as suggested by Ho (45). In reviewing Waterhouse's key of 1963, Hickman (40) stated that "he would hesitate to place P. fragariae in group V with the species in which all or the majority of the antheridia are paragynous". In general, the antheridia of P. fragariae are single-celled and long, measuring 17 ± 3 μm. Newhook et al. (71) listed the antheridia of P. fragariae as large, often more than 20 μm wide. Antheridia of this width was seldom observed in the present study or reported in literature. The overall mean width of antheridia for all the isolates of P. fragariae was 15 ± 2 μm. On the other hand, antheridia were often more than 20 μm long.

Chlamydospores have been reported for P. fragariae (3, 72). Such chlamydospore-like structures were sometimes observed in the old cultures of isolate ATCC 11109 and ATCC 13977. They were spherical (22-39 μm diam) and thin walled. However, they lacked the secondary wall and the internal re-organization of cell contents of chlamydospores (7,49). Thus, they were interpreted as unfertilized oogonia due to the absence of antheridia. In general, we agree with most other workers that P. fragariae does not produce chlamydospores.

In her key, Waterhouse (82) distinguished P. fragariae from P. megasperma based on the larger sporangia of the former (60 X 38 μm) and the smaller sporangia of the latter (less than 55 x 35 μm). Our study showed that while most isolates of P. fragariae produced large sporangia, some formed smaller sporangia. A study of 30 isolates of P. megasperma (Ho, unpublished), shows that the overall mean size of sporangia to be 56 (33-80) X 35 (23-45 μm). Thus, sporangial size alone cannot be depended upon to distinguish these two species. On the other hand, P. fragariae can be readily distinguished from P. megasperma by its conspicuously slower growth rate on cleared V-8 juice agar medium, producing thick and fluffy aerial mycelia and light brown coloration of the reverse, by its meandering and coiling hyphae with sparse but elongated branches, by the absence of large hyphal swellings or chlamydospores, by its slightly more elongated sporangia, by its infrequent production in single cultures of oogonia with tapered base and aplerotic to markedly aplerotic oospore, by its long, predominantly amphigynous antheridia, by its inability to grow at 30 C, no or poor growth on PDA, malt extract (4.5%), starch or inorganic nitrate agar medium and by its sensitivity to malachite green. Further, the mycelium of P. fragariae seemed to be more perishable, often losing its viability in stock cultures after 6 months. Tweedy and Powell (80) suggested that the death of P. fragariae in stock cultures was caused by an increase in the pH of the medium.

The high temperature variant of "P. fragariae" from Taiwan (10) was distinct in having much higher optimum temperature for growth (25-35 vs 20-22 C). It was deposited with the ATCC as Phytophthora sp. ATCC 44553. Indeed, we found that this isolate grew well at high temperatures with a maximum around 39 C but its cultural, morphological and physiological characteristics proved to be different from those isolates of P. fragariae studied here or reported in literature. It grew well on V8C, 4.5% malt extract agar and Difco PDA media, forming slightly fluffy colonies with distinct floral patterns. The growth rate on CV8 (7-8 mm per day) was faster than any P. fragariae isolates known and the characteristic light brown coloration of the reverse as seen commonly in our study was never produced. The hyphae were narrower (4-5 μm wide), free-branching and not coiling or meandering. They produced in water and in agar media many large spherical, oval, to irregular hyphal swellings averaging 33 ± 3 μm in diameter. Sporangia were produced rapidly and abundantly in water in 6-7 hours. No P. fragariae isolate in the present study sporulated within such a short period of time. The sporangia were shorter and wider, 54 ± 6 x 34 ± 3 μm with L/B ratio of 1.6 ± 0.2. It was resistant to malachite green, utilized soluble starch and inorganic nitrate well, and infected wounded apple fruit readily. Unfortunately, this isolate never produced sex organs in single cultures, in pairings or on oat grains. Nevertheless, the differences between this isolate and other known isolates of P. fragariae are so great that it should not be assigned to this species. In fact, it was very similar to the high temperature variant of P. megasperma from alfalfa (ATCC 38831) studied under the same conditions and should be treated as such until the sexual characteristics can be determined.

The new variety of *P. fragariae*: var. *oryzo-bladis*, (81), was not available for comparative studies. The "typ culture" deposited at Nanjing Agricultural University was seen by the senior author in 1983 but it proved to be a species of *Pythium* instead. Although the large oogonia (46.9 µm diam) with tapered base, the long antheridia with hyphal projection and the large obpyriform, internally proliferating sporangia (67x42.8 µm) produced on the rice seedlings suggest its affinity with *P. fragariae*, the remarkably fast growth rate of the fungus isolated (4-6.5 cm per day) and the rapid production of abundant chlamydospores (81) contrasted sharply with the slow growth and the absence of chlamydospores in *P. fragariae*. Furthermore, the culture failed to produce sporangia or sex organs *in vitro* (81) and it is questionable whether it was the same fungus as seen on the host. Thus, the identity of *Phytophthora* species causing rice seedling disease in China cannot be confirmed until the real causal agent can be isolated and its pathogenicity demonstrated.

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OBSERVATIONS ON HENDERSONIA PINICOLA AND THE NEEDLE BLIGHT OF PINUS CONTORTA

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ABSTRACT

Hendersonia pinicola, causal agent of a needle cast disease of Pinus contorta in the Pacific Northwest, induced initial disease symptoms and presented signs first in the lower parts of crowns and, later, in the upper parts of crowns. Ultimately, only distal parts of branches bore foliage. Diseased needles showed symptoms and signs at the apices, midsections, or both; needle bases remained green. Pycnidia of H. pinicola seated in the mesophyll of lodgepole pine needles extruded cirri of conidia through ostioles that pierced the host epidermis. Hendersonia pinicola and another needle cast fungus, Lophodermella concolor, sometimes coexisted on trees or even single needles. No consistent association was observed between these fungi. Field observations suggested that the capability of H. pinicola as a pathogen is not dependent upon the activities of other organisms. Inoculation studies of P. contorta with H. pinicola were inconclusive. Growth of H. pinicola in culture and histological details of the host-fungus relationship are described. Ultrastructural aspects of conidial wall development and morphology are reported. The verrucose surface of the mature conidium apparently results from the contours of globules of wall material.

Hendersonia pinicola Wehm. from *Pinus contorta* Dougl. ex Loud. var. *murrayana* (Grev. and Balf.) Engelm. (as *P. murrayana* Grev. and Balf.) was described by Wehmeyer (1946) in a study of various needle-inhabiting fungi from northwestern Wyoming. *Hendersonia pinicola* has been reported in British Columbia (Collis, 1972) and Idaho (Robert James, unpubl. information, via personal communication), among other places. The fungus has been observed principally on *Pinus contorta* (Collis, 1972). It causes gray necrotic zones in the center of the needles and causes their distal portions to turn reddish-brown and necrotic. Black masses of conidia are exuded from globose pycnidia that are immersed in host mesophyll (Wehmeyer, 1946).

Associations among *Hendersonia* species and various needle cast fungi of family Hypodermataceae, Discomycetes, have been reported by several researchers. Lagerberg (1910) alleged that *Hendersonia acicola* Tub. is the conidial state of *Lophodermella sulcigena* (Rostr.) Hoehn. [as *Hypodermella sulcigena* (Rostr.) Tub.]. However, Darker (1967) stated that *Hendersonia acicola* is a secondary fungus that attacks needles infected by hypodermataceous fungi and that it is not the anamorph of *L. sulcigena*. Darker (1932) observed a similar association between *Lophodermella montivaga* Petr. [as *Hypodermella montivaga* (Petr.) Dearn.] and *Hendersonia* sp. and believed *Hendersonia* to be a secondary fungus that invades after disease has been induced by other fungi. In addition to his description of *Hendersonia pinicola*, Wehmeyer (1946) noted that *H. pinicola* is associated with *Lophodermella concolor* (Dearn.) Darker in a manner parallel to the *H. acicola* - *L. sulcigena* association, i.e., as a secondary invader. Collis (1972) noted an association between *H. pinicola* and *L. concolor* in British Columbia. Funk (1985) considered *H. pinicola* to be a secondary fungus on *Pinus contorta* foliage, following *Lophodermella concolor* and *L. sulcigena*.

This study was conducted to examine biological, pathological, and cultural characteristics of *H. pinicola*.

MATERIALS AND METHODS

Field collection. Needles of *Pinus contorta* var. *latifolia* Engelm., lodgepole pine (LPP)(the nomenclature of Little, 1979) bearing pycnidia of *H. pinicola* were collected at the following sites: Big Meadow Creek, Latah County, ID (BMC); Laird Park, Latah County, ID (Laird); St. Regis, Mineral County, MT (Mont).

Inoculation studies. One hundred 2-year-old seedlings of LPP grown at the U.S. Forest Service nursery at Coeur d' Alene, ID., from seed obtained from the Elk City Ranger District at 4500 m in Nez Perce National Forest were planted in pressed fiber pots. Eighty trees were placed in a greenhouse and twenty trees in a lath house in Pullman, WA. The greenhouse was unheated and winter temperatures inside at times approached outside temperatures.

Inoculum suspensions were prepared using cultures of *H. pinicola* originating from conidia teased from LPP needles and grown on Difco potato dextrose agar with 5g/L Difco yeast extract (PDYA). After 1 month these cultures were flooded with sterile water to provide a conidial suspension of 8 X 10^6 - 9 X 10^7 spores/ml. Approximately 10 ml of this inoculum suspension was sprayed on each LPP seedling with an atomizer. Some seedlings were covered with clear polyethylene bags, which were removed after 2-21 days. Some of the inoculated seedlings were placed in a lath house, while others remained in the greenhouse. Sterile water was sprayed on control seedlings. Inoculations were made Oct 13, 1983, June 6, 1984, Aug 8, 1984 and May 1, 1985.

Cultural studies. Lodgepole pine needle epidermis was excised with a razor blade and pycnidia were hydrated with drops of sterile water. Conidia were removed directly from pycnidia and streaked onto 2% water agar. After germination, agar blocks with one to several conidia were cut out and transferred to one of the following media: PDYA; Difco oatmeal agar (OMA); or Bonar's modification of Leonian's agar (L)(Booth, 1971). Cultures were placed on laboratory benches at 21 C with 12 hr of fluorescent light.

Histological and ultrastructural studies. Needle tissue and agar-bearing mycelium were processed for eventual paraffin embedment and sectioning. Materials were fixed in formalin-acetic acid-alcohol (FAA) fixative (Berlyn and Miksche, 1976) and dehydrated with a graded ethanol series, followed by infiltration with xylene. The material was subsequently infiltrated with paraffin (Paraplast m.p. 57-58 C) and sectioned with a rotary microtome. Sections 12 μm thick were mounted on glass slides with Haupt's adhesive (Johansen, 1940) and deparaffinized with xylene. The agar material was stained with methylene blue and counterstained with aqueous basic fuchsin. Needle material was stained with safranin O and picro-aniline blue (Bradbury, 1973).

Some materials were processed for embedment in Spurr's resin and subsequent sectioning. A 2-month-old OMA culture of H. pinicola was dissected, 2 mm^3 pieces bearing pycnidia were placed in Karnovsky's fixative (Karnovsky, 1965) for 2 hr, then rinsed in 0.2M cacodylate buffer for ca. 15 min, and fixed in 2% osmium tetroxide (OsO_4) for 1.5 hr. The specimens were again rinsed in 0.2M cacodylate buffer and dehydrated in a graded ethanol series. The material was then infiltrated with propylene oxide-Spurr's resin (Spurr, 1969), and eventually moved into 100% Spurr's resin for three intervals of 4 hr each. After polymerization, 1 μm sections were cut with an ultramicrotome, and stained with brilliant green and safranin O.

Material for scanning electron microscopy (SEM) was fixed in Karnovsky's fixative (Karnovsky, 1965), rinsed twice in 0.2M cacodylate buffer, and post-fixed in 2% OsO_4. Subsequently, the material was rinsed twice in 0.2M cacodylate buffer, once in distilled water, and then dehydrated in a graded ethanol series. The material was critical-point-dried, gold-coated, and viewed with an ETEC Autoscan SEM. Material for transmission electron microscopy (TEM) was prepared in a manner identical to the procedure involving resin embedment. Subsequently, the material was sectioned with a microtome equipped with a diamond knife and placed on nickel grids. Some of the grids were viewed without additional processing; others were post-section-stained with uranyl acetate and Reynold's lead (lead citrate)(UA-RL)(Reynolds, 1963). An alternative post-section-staining procedure involved 5 min in barium permanganate (BAP), destaining 30 sec in 0.5% citric acid, staining 2 min in uranyl acetate and 2 min in Reynold's lead, with water rinses between steps (Hoch, 1977). A third procedure involved post-section-staining with periodic acid-Schiff's reagent (PAS) following the procedure of Martino and Zamboni (1967). All sectioned material was viewed with a Hitachi H-300 TEM.

Observations using light microscopy were made of material mounted in water or in dilute basic fuchsin. Photomicrographs of this material were taken with an American Optical Expostar differential interference contrast microscope (DIC) with an American Optical automatic shutter control, or with an American Optical brightfield microscope (BF). Kodak Technical Pan film 2415 was used. Photomacrographs were taken with an Orthophot camera or with a 4" X 5" camera.

Necrosis/Needle length study. It was noted that symptoms of H. pinicola commonly occur at the distal portion and midsection of a lodgepole pine needle, while the base of the needle remains green. To determine the relationship between the location of the initial infection site on the needle and the amount of necrotic tissue (mm) on the needle, one hundred of the previous year's needles were collected at Laird and BMC on May 20, 1984 and analyzed.

The association of Hendersonia pinicola - Lophodermella concolor. Fifty LPP needles with symptoms of H. pinicola (Hp) and L. concolor (Lc) were obtained at BMC, Mont, and Laird on June 8, 1984, July 15, 1984, and August 4, 1984, respectively. The epidermis on the abaxial and adaxial surfaces was severed and lifted with a razor blade, and by using a stereomicroscope the occurrence of fruiting bodies of these two fungi was recorded. The needles were categorized as possessing: Hp only, Lc only, Lc and Hp, or neither fungus.

RESULTS

Field observations. The disease caused by Hendersonia pinicola seems to spread from the lower portion of the crown upwards. In 20-yr-old LPP trees, foliage may be sparse and discolored at the base of the crown, while foliage higher in the crown appears healthy. In younger trees ca. 10-yr-old, symptoms may occur on all of the foliage, although the lower portion of the crown is usually most heavily damaged. On distal portions of branches, diseased foliage takes on a tufted appearance, often said to resemble a lion's tail, and occurs when 2-yr-old and 1-yr-old needles are prematurely cast. Necrosis begins at the distal end or midsection of the needle, rarely at the base. Often the base remains green when the fungus fruits more distally. In the necrotic zones black bands form which extend into the leaf mesophyll. On both the adaxial and abaxial sides of the needle, between the black bands, a grayish-brown zone appears. It is within this gray zone that pycnidia and conidia are produced.

In late May at BMC black bands occurred occasionally in the epidermis of 1-yr-old needles; however, they were most commonly located in the mesophyll. Small globoid pycnidia were present within the necrotic needle tissue between these bands. Even though pycnidial ostioles had not yet broken through the epidermis, conidia were being produced.

By mid-June new needles were emerging from buds. Within the gray zones of previous yr needles, pycnidial ostioles began to break through the host epidermis (Fig. 1). One month later, conspicuous tendrils (cirri) of conidia had exuded onto the needle surfaces. The spores adhered to the needles, forming soot-like crusts. By this time many of the 1-yr-old needles had fallen and the remaining needles were easily dislodged. By the end of July, the fully expanded new needles, which were adjacent to diseased needles of previous years, showed yellow, spherical spots with red centers that presumably were the first symptoms of the disease. Needles containing the yellow spots were plated on artifical media, but no fungal growth occurred from them.

Inoculation studies. No instance of infection resulting from artificial inoculations was observed.

Cultural studies. Hendersonia pinicola conidia begin to germinate within 24 hr after streaking onto agar (Fig. 10). Conidia similar to those produced by the fungus in situ are formed within 10 da on OMA. Fungal colonies are initially hyaline to grayish, later becoming black with a dense, whitish mycelial bloom. Colonies never cover the Petri plate, but tend to become mound-like owing to repeated overgrowing of underlying colonies (Fig. 2). The hyphae are warty, septate and hyaline, becoming olivaceous to brown with age. In old cultures, hyaline, thin-walled, globoid chlamydospores form. These highly guttulate chlamydospores (Fig. 9) may be terminal or intercalary. The ellipsoid to somewhat fusoid, smooth, yellow-brown, occasionally muriform conidia are typically 3-septate, but

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Figs. 1-11. Hendersonia pinicola. 1. Pycnidia breaking through needle epidermis, X 14. 2. Culture, X 0.5. 3. Section through pycnidium embedded in paraffin showing scattered conidia, X 230. 4. Section through pycnidium embedded in Spurr's resin showing scattered conidia, X 150. 5. Young conidium attached to conidogenous cell with swollen base (arrow), X 875. 6. Conidiogenous cell bearing conidium and showing frills reminiscent of annellations (arrow), X 1850. 7. Conidia, X 600. 8. Conidium, X 1100. 9. Two intercalary chlamydospores, X 1,000. 10. Conidium that has germinated from innermost two cells, X 1,100. 11. Section of conidium, X 5,000.

Figs. 1,2 by photomacrography. Figs. 3,4,7,8,10 by brightfield microscopy. Figs. 5, 9 by differential interference microscopy. Fig. 6 by SEM. Fig. 11 by TEM.

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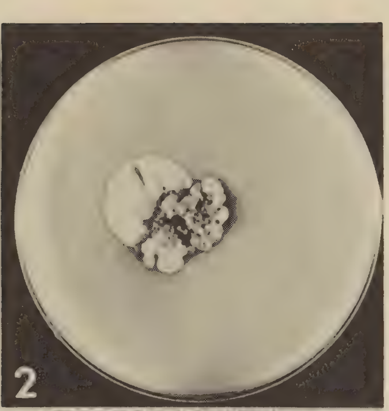
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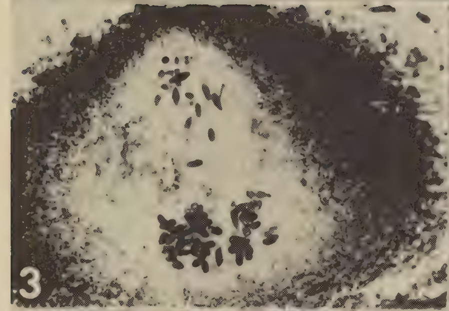
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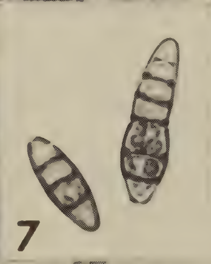
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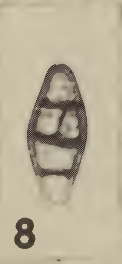
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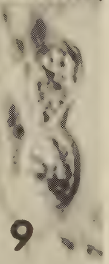
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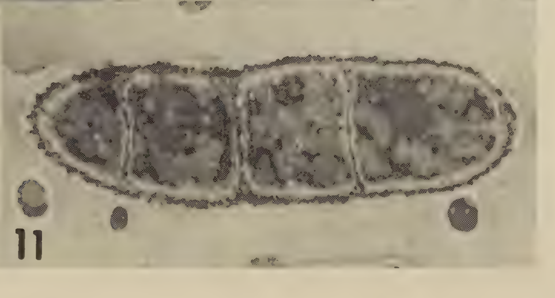
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can be 1-6 septate, (13-)17-21(-29) X (4.5-)5-7.5(-9) μm (Figs. 7,8,11,21,22), and germinate within 24 hr on various media. At first only central conidial cells germinate (Fig. 10), but germ tubes eventually originate from all conidial cells.

Histological studies. Stained and sectioned material of *H. pinicola* within LPP needles shows that branching, septate, rough-walled hyphae ramify inter- and intracellularly throughout host mesophyll tissue. Hyphae do not appear to penetrate the endodermis. Black globoid to irregular-shaped pycnidia containing abundant conidia (Figs. 3 and 4) and possessing papillate ostioles form in the upper mesophyll near the hypodermis. Conidiogenous cells, which commonly have a bulbous bases (Fig. 5), line the pycnidial walls. Pycnidia examined by SEM show that conidiogenous cells are sometimes branched and occasionally show ornaments reminiscent of annellations near the apices (Fig. 6).

Ultrastructural studies. A preliminary study of conidial wall development was made. The newly-formed conidial wall is initially electron-transparent (Fig. 12), but a conspicuous zone of small electron-dense globules soon develops within the innermost portion of the wall (Fig. 13). This zone of globules apparently migrates into the central portion of the wall, becoming more pronounced owing to the increasing size of globules and perhaps their numbers (Figs. 14-16). A homogeneous electron-transparent

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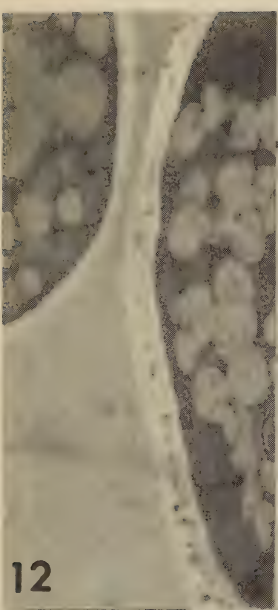
Figs. 12-19. *Hendersonia pinicola*. Sections of conidial wall by TEM. 12. Wall of newly-formed conidium. Unstained after fixation, X 7,000. 13. Wall of newly-formed conidium. Zone of globules (arrow). Unstained after fixation, X 12,000. 14. Wall of young conidium. Note zone of globules in electron-transparent wall. Post-section-stained with BAP, X 20,000. 15. Similar to Fig. 14, but not stained after fixation, X 20,000. 16. Wall of developing conidium showing prevalence of globules within wall. Post-section-stained with BAP, X 20,000. 17. Wall of maturing conidium showing globules (b) near surface embedded in more electron-transparent material (c) and underlain by comparatively electron-transparent inner wall (a). Post-section-stained with UA-RL, X 20,000. 18. Roughened outer layer of mature conidium (b) and underlying layer (a). Post-section-stained with UA-RL, X 13,000. 19. Roughened outer layer of mature conidium. Post-section-stained with BAP, X 9,000.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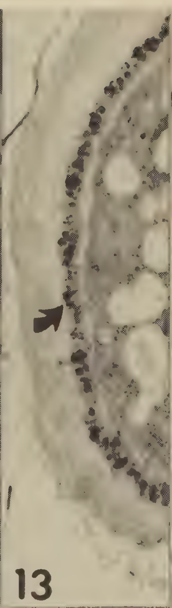
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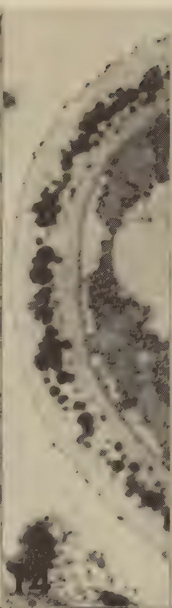
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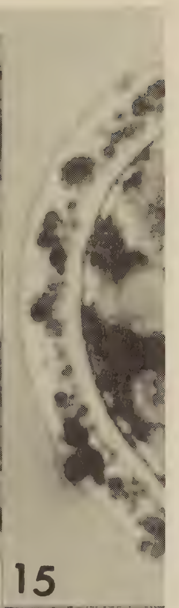
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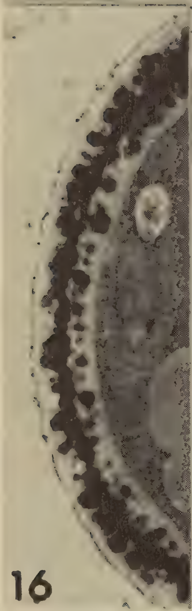
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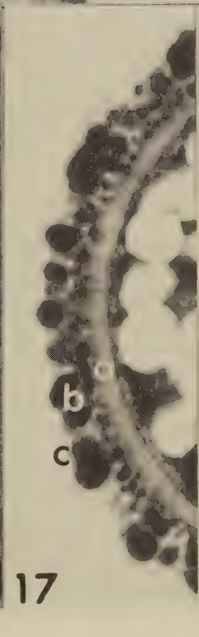

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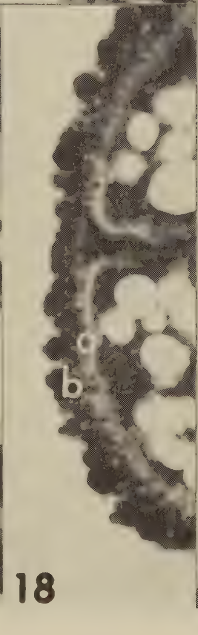

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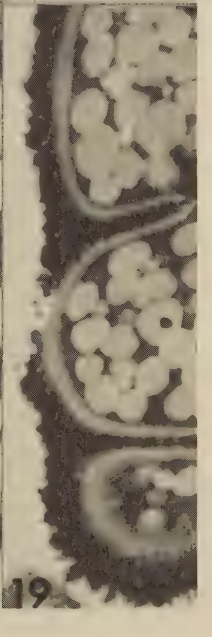
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wall layer develops beneath the globular zone (Figs. 17, 20). The globular zone now comprises a part of the outermost region of the wall, the globules embedded in a matrix of electron-transparent material (Figs. 17,20,23). The surface of the maturing conidium is seen to be highly verrucose (Figs. 18,19,21,22). The verrucae are apparently the surface contours of globules and, presumably, the collapsed and adhering remains of overlying electron-transparent material. The globular layer also forms between individual cells of the conidium and completely encapsulates them (Fig. 22). The outermost globular layer becomes brittle and can be separated and broken away cleanly from the conidium by mechanical means and is fractured during germination by germ tubes. Removal of this layer exposes the more regular innermost wall layer (Fig. 24). Individual cells of a conidium can likewise be separated by coverslip pressure; separation occurs in the globular zone of the wall.

Necrosis/Needle length. Concerning Laird samples, the mean percentage of length of necrotic tissue/total length of needles with the distal portion necrotic was 70.26, while the mean percentage for needles with the midsection of the needle necrotic was 53.26. Concerning BMC samples, the mean percentage for distally necrotic needle tissue was 76.18, and the percentage for midsection necrosis on needles was 58.45. Duncan's multiple range test (P=0.05) showed there was no significant difference between site locations, but there was a significant difference when necrosis at the tip of the needle was compared with

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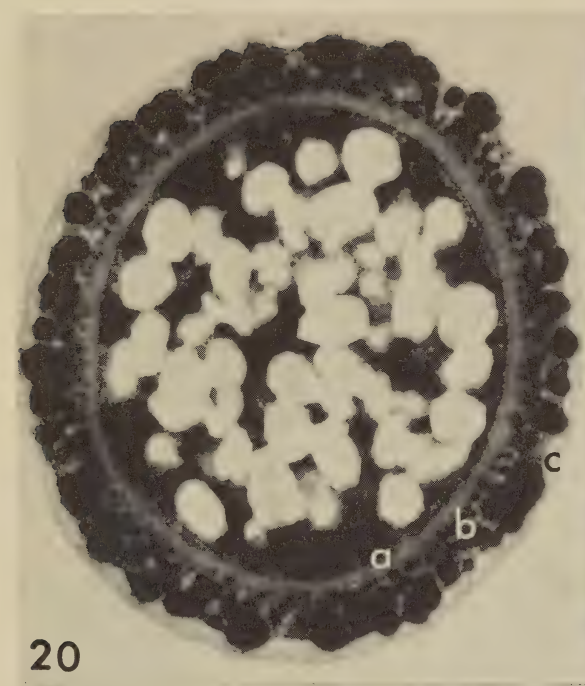
Figs. 20-24. Hendersonia pinicola. Details of conidial wall. Fig. 20. Cross-section through maturing conidium showing inner wall layer (a), conspicuous middle zone of globules (b), and thin electron-transparent outermost zone (c). Post-section-stained with UA-RL, X 20,000. 21. Scanning electron micrograph showing conidial surface roughened by globular verrucae, X 4,000. 22. Longitudinal section of maturing conidium showing electron-transparent inner wall layer, conspicuous zone of globules, and traces of the electron-transparent outermost zone. Post-section-stained with UA-RL, X 8,000. 23. Portion of wall showing globules (b) embedded in electron-transparent material (c) and underlying electron-transparent wall (a). Post-section-stained with UA-RL, X 48,000. 24. Portion of conidium where globular layer (b) has been removed from inner layer (a). Post-section-stained with PAS, X 20,000.



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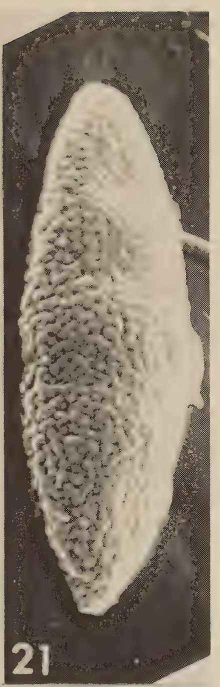

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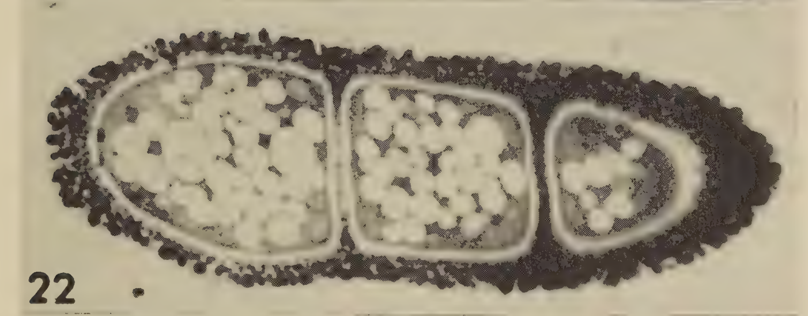

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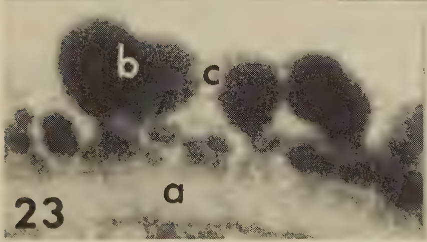

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necrosis at the midsection of the needle. When necrosis occurred at the tip of the needle, there was more necrosis per total needle length than when necrosis occurred only at the midsection of the needle.

Hendersonia pinicola - Lophodermella concolor association. At BMC (Table 1), *H. pinicola* occurred most often in association with *L. concolor* in LPP needles; it rarely occurred alone. On the other hand, *L. concolor* frequently occurred alone at BMC. *Hendersonia pinicola* was never observed alone on needles from Mont, but often appeared in conjunction with *L. concolor*. At Laird and Laird-Strychnine, trends somewhat different from the other sites were noted. At Laird *Hendersonia pinicola* was commonly found alone, and was also frequently observed with *L. concolor*. However, at the Laird-Strychnine site, there appeared to be no association between two fungi. *Lophodermella concolor* rarely was observed alone, whereas *H. pinicola* was commonly found alone. There does not appear to be a consistent association between these two fungi, at least at the locations studied.

Table 1. Assessment of the *Hendersonia pinicola* - *Lophodermella concolor* association based on the presence of fructifications of one or both fungi on needles of *Pinus contorta*

Location/date	Number of needles with fructifications			
	Hp	Lc	Lc & Hp	neither
BMC # 1: 6/8/84	0	30	5	15
BMC # 4: 6/8/84	5	10	35	0
BMC # 1: 7/15/84	2	20	15	13
Mont # 5: 8/4/84	0	27	23	0
Laird # 6: 6/8/84	23	3	22	2
Laird-Strychnine # 8: 6/8/84	34	8	0	8

DISCUSSION

As noted in the introduction *Hendersonia pinicola* has been assumed to be a secondary fungus associated with pathogenic species of *Lophodermella*. The data from our collection sites indicate that there is no consistent association between *H. pinicola* and *L. concolor* (Table 1). At the study sites there were severely blighted trees on which *H. pinicola* occurred alone. In our opinion, *Hender-*

sonia pinicola is a facultative saprophyte which can be a primary pathogen of lodgepole pine.

It was demonstrated that when necrosis caused by *H. pinicola* occurs at the distal end of the needle, a greater portion of the needle becomes necrotic than when necrosis occurs only at the midsection of the needle. Because the tip emerges from the bud first, it is exposed to the environment for a longer period of time than the midsection or base of the needle, thus possibly explaining why symptoms are most common at the tips of needles. Also, it is possible that the tips are most susceptible to fungal attack and it is likewise possible that spore availability is greater at the time that the needles are first emerging from the bud.

Results of greenhouse pathogenicity studies were disappointing. In no case did disease symptoms appear. Unknown or poorly understood environmental or host factors may be necessary for infection of lodgepole pine foliage by *H. pinicola*.

In culture *Hendersonia pinicola* is slow-growing and grows upon itself, forming mound-like colonies. We also observed this type of growth in cultures of two other needle cast fungi, *Dothistroma septospora* (Dorog.) Morelet (= *Dothistroma pini* Hulbary) and *Leptomelanconium pinicola* (Berk. & Curt.) R. S. Hunt [= *Gloeocoryneum cinereum* (Dearn.) Weindlmayr]. The localized growth of these fungi in foliage can apparently be predicted from their limited and localized colonies on agar media. Investigators culturing foliage pathogens are frequently frustrated by the slow-growing localized colonies produced by many of these fungi. In our opinion, these fungi may lack the genetic capacity for a more "normal" (rapid and extensive) type of cultural growth.

Pycnidia of *H. pinicola* are seated in the upper mesophyll near the hypodermis of the needle. The papillate ostiole is the only portion of the pycnidium which reaches above the host epidermis (Fig. 1). The sheltered position of the pycnidium might be of survival value during unfavorable environmental conditions such as cold winter temperatures, intensive solar radiation, high summer temperatures, and desiccation.

A preliminary study of the conidium wall indicates that it is composed of two distinct layers, the outermost of which develops from globules of material embedded in a more homogeneous matrix. It is also possible to interpret the wall as composed of 3 layers if the outermost electron-transparent material is interpreted as distinct from the matrix in which the globules are embedded. In any case, the outer layer is easily removed by exerting pressure on a coverslip. Individual conidial cells can be separated by pressure and the rupture occurs in the globular zone. It might thus be possible to consider the conidium as distoseptate. It is probable that the thick outer layer is advantageous to the fungus in bearing a substantial part of the pigment(s) that protects the conidium from ultraviolet damage while exposed on the needles surface. It is likewise probable that it reduces water loss from the conidium. It undoubtedly has properties that allow the conidium to adhere to pine foliage. The fact that the outer wall layer is easily ruptured by germ tubes and other mechanical means seems advantageous to the fungus in that the conidium can have the advantages of a heavy wall without requiring preformed germination sites such as pores or slits.

At the study locations, LPP is abundant but not considered an economically important species. In other areas where forest fires often occur the species is important because of its serotinous cones which contribute toward rapid reforestation. In some areas in the Pacific Northwest LPP reaches merchantable size. *Hendersonia pinicola* slows growth of LPP by killing new needles, thereby reducing photosynthetic activity necessary for adequate diameter and height growth. Thus, after several years *H. pinicola* causes a decline in growth and vigor. Eventually, small trees are killed.

ACKNOWLEDGMENTS

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ANOTHER NEW HYPHOMYCETE FROM LEAF LITTER

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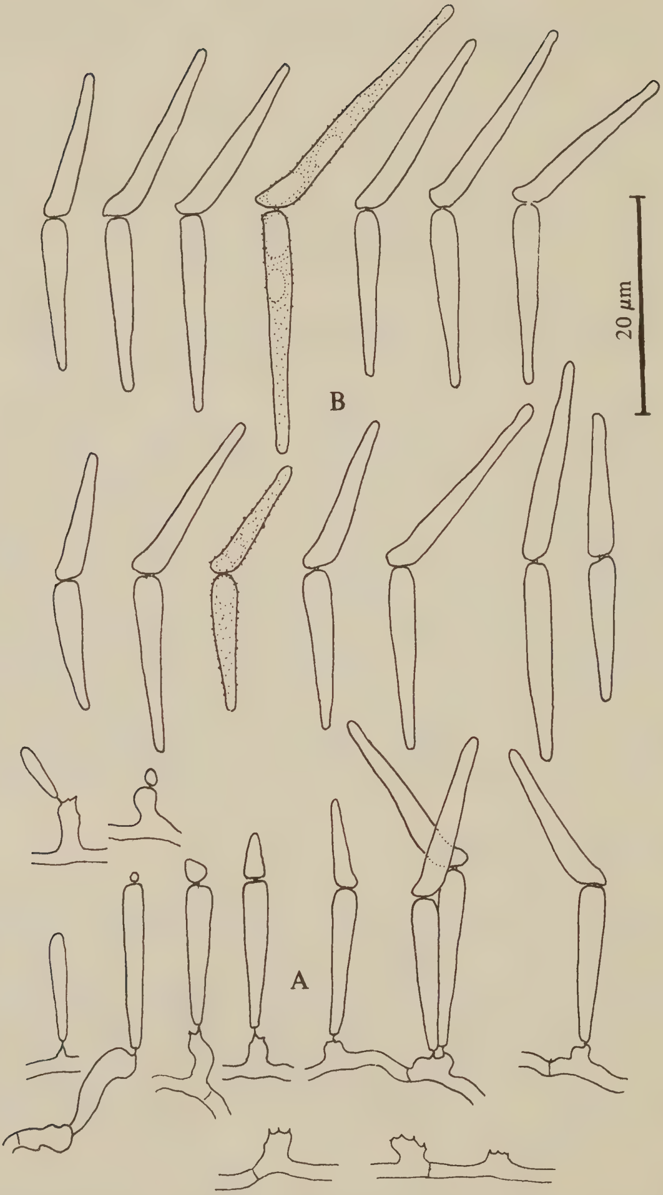
Isthmolongispora geniculata sp.nov., a leaf litter inhabiting hyphomycete with subhyaline, bicellular, constricted, bent conidia is described and illustrated.

Isthmolongispora was established by Matsushima(1971) for two hyphomycetes, **I.intermedia** Matsushima and **I.minima** Matsushima found on decaying leaves from the Solomon Islands and Papua-New Guinea. Seven additional species have been described since then (Matsushima, 1975, 1987, de Hoog & Hennebert, 1983, & Arambarri et al. 1987). The genus is characterised by having short, simple to poorly formed denticulate, sympodially proliferating conidiophores arising from the vegetative hyphae. Conidia arise from denticles in succession and are narrowly clavate to filiform, bicellular to multicellular; the cells making up the conidia are connected by very narrow isthmi. A recent collection of submerged decaying leaves incubated in moist chambers yielded a hyphomycete which fits well into this genus but does not agree with any of the described species and is described below as a new species.

Isthmolongispora geniculata sp.nov. (Figs 1 – 2)

Coloniae in foliis putridis expansae, albidae vel griseolae. Mycelium plerumque superficiale, ex hyphis laevibus, subhyalinis vel pallide fuscis, ramosis, septatis, 1.5 – 2.0 µm latis compositum. Cellulae conidiogenae sparsae, e hyphis lateraliter vel terminaliter in ramis integratae oriundae, saepe modice inflatae; denticuli conidiogeni cylindrici in cellulis conidiogenis terminali aggregati. Conidia subhyalina, pallide brunneo-grisea in massa, laevia vel minute verruculosa, bicellularia, in medio flexa et profunde constricta per isthmum brevem connexa, 30 – 47 µm longa x 2 – 3 µm crassa.

Ex foliis angiospermis putrescentibus in flumine immersi, Pasuh Forest Reserve, Negri Sembilan, 18 Nov. 1986, A. Nawawi, IMI 319609 holotypus.


B
20 µm
A

Colonies on the leaves extensive, whitish to greyish, powdery upon sporulation. Mycelium mostly superficial, often creeping up debris and setae of other fungi present, composed of smooth, subhyaline to pale fuscous, branched, septate 1.5 – 2.0 µm wide hyphae. Conidiogenous cells scattered, arising from undifferentiated hyphae or integrated on short lateral branches, wedge-shaped to ampulliform, sometimes slightly swollen; conidium-bearing denticles short, thread-like, 1 – 5 grouped in the apical regions. Conidia light brownish grey in mass, subhyaline, smooth to minutely verruculose, bicellular, bent at an angle of 130° – 160° at the markedly constricted median septum; the two cells connected by a very narrow isthmus. The basal cell is narrowly clavate with a rounded apex, 15 – 22 µm long x 2 – 3 µm wide. The distal cell is similarly shaped but readily distinguished from the basal cell by the presence of a small protuberance at the base, somewhat resembling a hockey stick. The total length of the mature conidia ranges from 30 – 47 µm, and the distal cell usually exceeds the basal cell by 1 – 3 µm.

Other specimen examined: On submerged decaying leaves incubated in moist chambers, Mimaland, Selangor, 18 Apr. 1987, A. Nawawi.

During conidial development, each conidium starts as a minute, round, hyaline bud growing out from the tip of a denticle. This bud lengthens to become rod-shaped and finally narrowly clavate with a rounded apex. When it reaches 12 – 15 µm long a similar bud grows out from its apex and lengthens to become triangular and finally narrowly clavate. It is connected to the basal cell by a very short, narrow isthmus. The apex of the first cell remains rounded while the base of the second cell develops a notch at one side and as a result it does not grow straight up but bends slightly to one side. The conidiogenous cell proliferates sympodially and up to 5 conidia have been observed growing from one. Conidia secede by a break in the denticle very close to the base, leaving a short, thread-like stump on the conidiogenous cells. The remains of the denticles are not visible in detached conidia.

Conidia germinate readily on agar media by producing germ-tubes from the tips of the cells. On CMA the colony is compact, appressed, initially creamish, but later turning light chocolate brown with sparse, grey aerial mycelium; reverse brown. It is of moderate growth, reaching a diam. of 31 mm in 48 days at

Fig.1. **Isthmolongispora geniculata.** (A) Stages in conidial formation arranged in a developmental series from leaves; (B) Conidia.

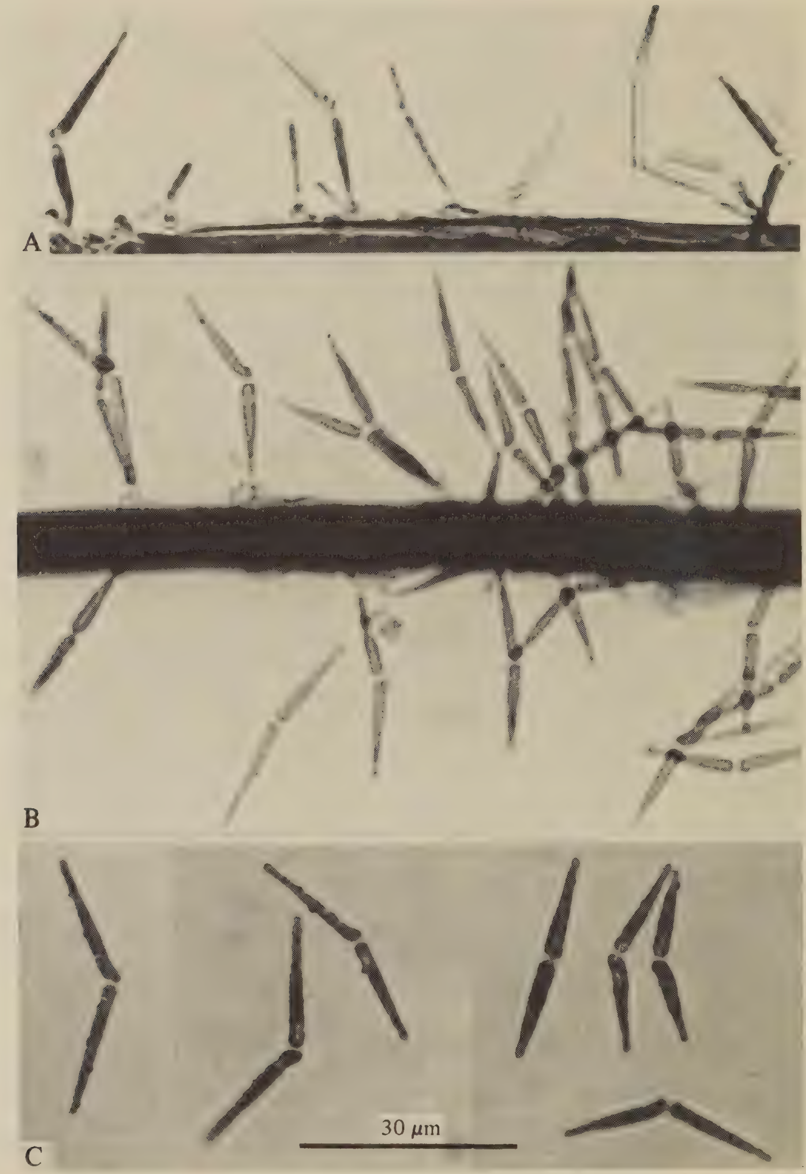


Fig.2. **Isthmolongispora geniculata.** (A – B) The fungus creeping up and sporulating on setae of **Wiesneriomyces laurinus;** (C) Typical conidia.

25 – 28°C. Sporulation is abundant, occurring close to the agar surface or on aerial mycelium. On agar, the conidia tend to be shorter, sparsely punctate and the majority with a slight bend at the septum.

The morphology of the conidiogenous cells and the conidia are the main characteristics which suggest the inclusion of this fungus in the genus **Isthmolongispora.** The distinctly bent conidia of **I.geniculata** are at present unique in the genus and at once distinguish this species from all others. It appears to be most closely related to **I.minima** which also produces bicellular conidia whose cells are connected by narrow isthmi. However, conidia of **I.minima** are straight, fusiform and shorter (16 – 30 µm x 2.5 – 3 µm) and the basal cell is indistinguishable from the distal cell.

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THE BLOXAMIA ANAMORPH OF BISPORELLA DISCEDENS

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ABSTRACT

A *Bloxamia* anamorph is reported for *Bisporella discedens* (Karsten) Carpenter. The anamorph was found on host tissue in association with the teleomorph, on the sides of the apothecia, and was produced in culture from single ascospores.

INTRODUCTION

There have been four reports of anamorphs associated with the genus *Bisporella* Saccardo (= *Calycella* Quélet), a member of the Helotiales. Berthet (1964) reported a *Bloxamia* anamorph in culture from single ascospore isolations of *Calycella sulphurina* (Quélet) Boudier (= *Bisporella sulphurina* (Quélet) Carpenter). Carpenter (1975) reported the anamorph of *Bisporella discedens* (Karsten) Carpenter as *Cystodendron* sp., although he was uncertain of the genus to which the anamorph should be assigned and considered that affinities with *Chalara* were possible. Carpenter (1981) reported a *Cystodendron* anamorph for *Bisporella polygoni* (Velenovsky) Carpenter. Carpenter (1975, 1981) found the anamorphs developing on the receptacle of the teleomorph apothecia, and the links were not proven experimentally. The anamorph of *Bisporella resinicola* (Baranyay & Funk) Seifert & Carpenter was placed in the genus *Eustilbum* Rabenhorst by Seifert & Carpenter (1987). This anamorph-teleomorph link was proven by single ascospore isolations by Baranyay & Funk (1969). *Bisporella pallescens* (Persoon : Fries) Carpenter & Korf is usually found growing in association with the conidial fungus *Bispora monilioides* Corda, but this probably represents a mycoparasitic rather than an anamorph- teleomorph relationship (Korf & Carpenter 1974).

This paper reports the anamorph of *Bisporella discedens* from New Zealand, both from the host and from culture following single ascospore isolations. Single ascospore isolations were also made from *B. citrina* (Batsch : Fries) Korf & Carpenter, another species of *Bisporella* commonly found in New Zealand, but no anamorph was found.

RESULTS

Bisporella discedens was reported from New Zealand by Dennis (1961) (as *Calycella discedens* (Karsten) Dennis), and is common on bark, old pyrenomycete fruiting bodies, and palm fronds, mainly in the north and west of the North Island. The New Zealand collections are typical of *B. discedens* as re-described by Carpenter (1975).

Single ascospores were isolated from two collections (PDD 45590, 45599), and colonies derived from these were grown on Difco cornmeal dextrose agar (CMD) for 21 days at 18°C under near-ultraviolet and cool-white fluorescent light, with a cycle of 12 hour light/12 hour dark. Ascospores germinated within 24 hours and cultures on CMD were 15-20 mm diam. after 21 days. Aerial mycelium was lacking, agar was not discoloured, the colony surface was white except for the black, flat, up to 0.5 mm diam. sporodochia which developed in a ring near the centre of the colony. The sporodochia became greyish in colour following the production of conidia. The sporodochia comprised a 30-50 μm wide base of pseudoparenchymatous tissue on which a tightly packed palisade of pale brown, cylindrical, 50-80 x 2-2.5 μm conidiogenous cells was held. The conidiogenous cells were septate in the lower half, and at the apex were tube-like and contained several conidia. The conidia were hyaline, nonseptate, rectangular in outline, 2.5-4.5 x 1.5-2 μm, held in readily disarticulating chains. No apothecia formed.

In several herbarium collections (PDD 19385, 19387, 19390, 19048, 25678, 29816, 45592) sporodochia were found on the host in association with the *Bisporella* apothecia (Fig 1). These sporodochia were initially black, discoid, more or less circular, 0.3-1.0 mm diam. Following the production of conidia the upper

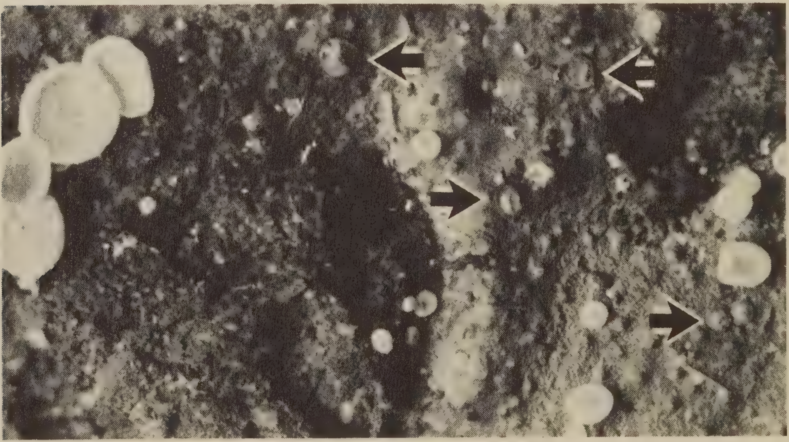
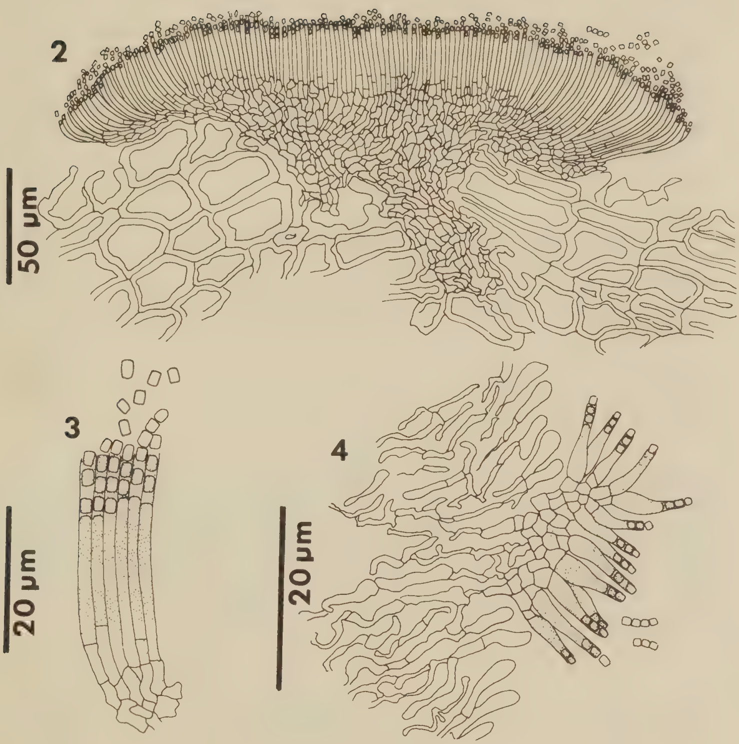


Fig 1 Macroscopic appearance of *Bisporella discedens* and *Bloxamia* anamorph, sporodochia of anamorph indicated by arrows (PDD 29816).



Figs 2-4 *Bloxamia* anamorph of *Bisporella discedens.* **Fig 2** Vertical section of sporodochia on host tissue (PDD 29816); **Fig 3** Detail of conidiogenous cells and conidia from sporodochia on host tissue (PDD 29816); **Fig 4** Anamorph conidiogenous cells and conidia on outside of gelatinous excipulum of teleomorph apothecium (PDD 19385)

surface of the sporodochia became silver-grey in colour. The sporodochia were erumpent from the host tissue, in vertical section were up to 70 m deep, with the basal part, on which the conidiogenous cells are held, comprising hyaline, thin walled, pseudoparenchymatous cells (Fig 2). The conidiogenous cells were pale brown, thin walled, cylindric, 20-28 x 2-2.2 μm, forming a densely-packed palisade (Fig 3). The apex of the conidiogenous cells were tube-like and contained 3-5 conidia. The conidia were hyaline, non-septate, rectangular to more or less square in outline, 1.8-2 x 2- 2.5 μm, released singly or held in readily disarticulating chains.

In the collections listed previously, as well as PDD 19381, 19383, 19389, and 46157, conidiogenous cells and conidia were found attached to the outer excipular layer of the teleomorph apothecia (Fig 4). The apex of the conidiogenous cells and the conidia were similar to those described above from sporodochia, but the conidiogenous cells were shorter (16-19 μm) and slightly swollen near their bases. In some collections there were chains of up to 15 conidia. The conidiogenous cells were in loose groups of up to about 20, and at their base was a narrow layer of thin-walled, angular cells.

The second species, *Bisporella citrina*, is found in New Zealand in the South Island and lower half of the North Island, mostly on decorticated wood of various hosts and on bark of *Nothofagus* spp. Cultures were grown from single ascospores isolated from several collections, including PDD 43162, 45873, 49449, and 49499. The cultures were similar in growth rate and appearance to those described for *B. discedens* but sporodochia did not develop, and they remained sterile. No anamorph was seen in association with the apothecia.

DISCUSSION

I have followed Dennis (1961) in referring the New Zealand collections to *Bisporella discedens*. However, it is uncertain whether *B. discedens* can be distinguished from *B. sulphurina* (Dumont 1981). If the two names are found to represent the same species then *B. sulphurina* would have nomenclatural priorty.

The anamorph described above for *B. discedens* is *Chalara*-like in the structure of its conidiogenous cells and conidia. Because the conidiogenous cells may develop in sporodochia the anamorph should be assigned to the closely related genus *Bloxamia* Berkeley & Broome (Nag Raj & Kendrick 1975). The anamorph closely resembles *Bloxamia truncata* Berkeley & Broome, the type species of the genus (Pirozynski & Morgan-Jones 1968, Nag Raj & Kendrick 1975). The morphology of the *Bisporella discedens* anamorph in culture agrees with the description and illustrations of Berthet (1964) for the anamorph of *B. sulphurina*.

The way in which the conidiogenous cells of the anamorph of *Bisporella discedens* are arranged varies according to substrate. On host tissue and in culture discoid sporodochia form, while on the apothecia loose aggregations of small numbers of conidiogenous cells are found. Carpenter (1975) referred the anamorph found on apothecia to the genus *Cystodendron*. The arrangement of the conidiogenous cells is similar to that illustrated for *Cystodendron* (Ellis 1971, Carmichael et al. 1980), however the structure of the conidiogenous cells and conidia indicates a relationship with *Chalara* rather than with *Cystodendron*. This relationship is supported by the structure of the anamorph in culture and from host tissue.

The *Eustilbum* anamorph described by Baranyay & Funk (1969) (as *Stilbella*) and Seifert & Carpenter (1987) for *Bisporella resinicola* is morphologically very different from the *Chalara*-like anamorphs of *B. discedens* and *B. sulphurina*. This may simply reflect the unusual substrate of conifer resin on which *B. resinicola* develops, or may indicate that *Bisporella* as currently delimited is heterogeneous.

SPECIMENS EXAMINED

New Zealand: AUCKLAND, Waitakere Ra., Kauri Knoll Tr., on *Rhopalostylis sapida*, coll. Johnston, 29 Apr 1987 (PDD 45590); Hunua Ra., on *Hedycarya arborea*, coll. Dingley, 28 Mar 1954 (PDD 19390); Mt. Albert, on *Leptospermum scoparium*, coll. McKenzie, Sep 1948 (PDD 19385); Titirangi, on *Dysoxylon spectabilis*, coll. Dingley, 6 Jun 1949 (PDD 19383); Titirangi, on *Coprosma robusta*, coll. Dingley, 20 Jun 1950 (PDD 19389). COROMANDEL, Thames, on *Muehlenbachia australis*, coll. Dingley, 10 Jun 1950 (PDD 19048). GISBORNE, Urewera Nat. Park, Black Beech Tr., on decort. wood, coll. Samuels et al., 22 May 1981 (PDD 49449); Urewera Nat. Park, Ngamoko Tr., on decort. wood, coll. Samuels et al., 21 May 1981 (PDD 49499). WANGANUI, vic. Kai Iwi, Bushy Park Res., on *Ripogonum scandens*, coll. Johnston, 15 May 1987 (PDD 45599); vic. Kai Iwi, Bushy Park Res., on *Rhopalostylis sapida*, coll. Johnston, 16 May 1987 (PDD 45592); vic. Wanganui, on *Beilschmiedia tawa*, coll. Dingley, 6 Mar 1946 (PDD 19381); vic. Kai Iwi, Bushy Park Res., coll. Johnston, 16 May 1987 (PDD 46157). WELLINGTON, Kandallah Reserve, on *Brachyglottis repanda*, coll. Dingley, Dec 1948 (PDD 19387); Hutt, Days Bay, on ?*Hypoxylon* sp., coll. Dingley, 22 Feb 1972 (PDD 29816). NELSON, Waimea, on *Nothofagus* sp., coll. Dingley, 2 Mar 1967 (PDD 25678); Mt. Arthur, on decort. wood, coll. Samuels et al., 18 May 1983 (PDD 45873). BULLER, vic. Murchison, along road toward Maruia Saddle, on *Nothofagus* sp., coll. Samuels et al., 11 May 1982 (PDD 43162).

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Rust fungi (Uredinales) on Poaceae, mainly from Africa

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ABSTRACT

Fiftythree rust taxa on hosts belonging to Poaceae are reported. Fifteen species are described as new, viz. Puccinia apochitonis on Apochiton burtii, P. trachypogonicola on Trachypogon chevalieri, P. trichopterygicola and P. trichopterygiphila on Trichopteryx fruticulosa, P. triraphidis on Triraphis schinzii, Uredo elymandrae on Elymandra androphila, U. eragrostidiphila on Eragrostis kiwuensis, U. eragrostidis-capensis on Eragrostis capensis, U. leersiae on Leersia hexandra, U. trichopterygis-dregeanae on Trichopteryx dregeana, Uromyces chaetobromi on Chaetobromus schraderi, U. clignyioides on Monocymbium ceresiforme, U. eragrostidicola on Eragrostis rigidior, U. habrochloae on Habrochloa bullockii, and U. pentaschistidis on Pentaschistis aizoides, all from Africa. Species new to Africa are P. chrysopogi on Heteropogon contortus, P. faceta on Olyra latifolia, P. lepturi on Lepturus radicans, P. sessilis on Phalaris arundinacea, Uromyces obesus on Heteropogon contortus and U. turcomanicum on Hordeum bulbosum and H. marinum ssp. gussoneanum. New hosts are recorded.

Keywords: Uredinales, Rusts, Poaceae.

Most of the material presented in this paper belongs to the Herbarium of the Royal Botanic Gardens Kew (Herb. K). A few specimens belong to the Botanical Museum in Copenhagen (Herb. C) and to the Norwegian Plant Protection Institute (NPPI). The rust names and species concept follow that used by Cummins (1971) in his monograph. For synonyms of the rusts see the same publication.

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PHAKOPSORA INCOMPLETA (Syd.) Cumm. in Mycologia 42: 786 (1950).
On *Andropogon distachyos* L.
Ethiopia. W of Harar, 2500-3000 m, 29.09.1961, W. Burger (1014), II; Addis Ababa, 2800 m, 29.11.1935, H.F. Mooney (5026), II.
On *Andropogon eucomus* Nees
Malawi. Zomba, 28.04.1950, P.O. Wiehe (N/498), II.
On *Themeda triandra* Forssk.
Zimbabwe. Bikita distr., 1000 m, 10.05.1969, H.M. Biegel (3096), II.

A. distachyos is a new host for this rust which occurs on several genera in Africa and Asia.

PHAKOPSORA LOUDETIAE Cumm. in Bull. Torrey Bot. Club 83: 223, 1956.
On *Loudetia kagerensis* (K. Schum.) Hutch.
Uganda. Entebbe road, mile 13, 03.1930, C.G. Hansford (1130), II.

This specimen was published by Wakefield & Hansford (1949) as *Puccinia loudetiae* Wakef. & Hansf. However, the curved, dorsally thickened paraphyses, the pale wall of the urediniospores and obscure pores indicate it should be placed within the genus *Phakopsora*.

PHYSOPELLA AFRICANA (Cumm.) Cumm. & Ramachar in Mycologia 50: 742 (1958).
On *Brachiaria decumbens* Stapf
Kenya. Kitale, 04.09.1956, A. Bogdan (4254), II + III.

This rust species is known only from Kenya and Uganda, occurring on *Brachiaria* spp.

PUCCINIA AGROPYRI-CILIARIS Tai & Wei in Sinensia 4: 110, 1933.
On *Agropyron semicostatum* Nees
China. Shantung, Tsingtao, 07.06.1930, C.Y. Chiao (2414), II + III.

The host is new to this rust in China, but it has been reported from Japan.

PUCCINIA ANDROPOGONICOLA Har. & Pat. in Bull. Mus. Hist. Nat. Paris 1909: 199 (1909).
On *Cymbopogon caesius* (Hook. & Arn.) Stapf

Sudan. Kelling, Jebel Marra, 1900 m, 17.04.1964, G.E. Wickens (1472), II + III.

On *Cymbopogon commutatus* (Steud.) Stapf

Ethiopia. Eritrea, Merriam, below Mei Mapales, 31.04.1894, G. Schweinfurth (45), III; Tigré, Adeneato, 10.12.1909, Chiovenda (1243), III.

Sudan. Darfur Prov., E of Kebkabiya-Zalingei road, about 65 km from Kebkabiya, 1000-1100 m, 01.01.1934, J.E. Dandy (739), III; Darfur, 09.1921, H. Lynes (528), III; Jebel Sirmi in Jebel Marra, 01.10.1964, G.E. Wickens (2763), III.

On *Cymbopogon giganteus* Chiov.

Uganda. Mt Elgon, Simii valley to Siroke valley, 1250 m, 12.12.1927, J.D. Snowden (1246), II.

Central African Republic. E Chari, Snoussi Co., Dar Banda, Ndélé, 1902-04, A. Chevalier (6832), II + III.

On *Cymbopogon martinii* (Roxb.) Wats.

Zimbabwe. Umoukweo, 04.10.1953, R. Pollett, II.

P. andropogonicola is widespread in Africa, occurring on many host genera. *C. commutatus* and *C. martinii* are new hosts for this rust, while *C. giganteus* has been reported from Ghana. Yadav (1963) mentioned a rust as *P.* sp. on *C. caesius* from India, indicating it might be *P. andropogonicola*. If so it is the only record outside Africa.

PUCCINIA ANDROPOGONIS-HIRTI Beltrán in Mem. R. Soc. Espan. Hist. Nat. 50: 252 (1921).

On *Andropogon chinensis* (Nees) Merr. (syn. *A. schinzii* Hack.)

S. Afrika. Transvaal, Pretoria distr., Wonderboom reserve, 05.04.1945, J.E. Repton (2070), II + III.

A. chinensis is a new host for this rust not previously reported outside the Mediterranean area (Corsica, Tunis and Turkey) on *Hyparrhenia hirta* (L.) Stapf (syn. *A. hirti* L.). The teliospores are not or very little thickened at the apex and the pedicels relatively thick-walled, not collapsing and mostly short, but occasionally measuring up to 55 µm. The related *P. eritraeensis* Paz. has teliospores distinctly thickened at the apex and longer, usually collapsing pedicels.

PUCCINIA APOCHITONIS sp.nov. (Fig. 1)

Aecidia et uredinia ignota. Telia amphigena, exposita, pulvinata, fusca. Teliosporae 27-35 x 20-23 µm, late ellipsoideae, raro diorchidioideae, pariete laterali 2.5-3 µm crasso, ad apicem usque 5.5 µm incrassato, cinnamomeo, laevi, pedicello prope sporam pallide brunneo, aliter hyalino, collabente, usque 85 µm longo.

Holotype: H.J. van Rensburg 495 (K), 28.08.1951, Tanzania, Southern Highlands, Chimala on *Apochiton burtii* C.E. Hubbard.

No rust has previously been reported for *Apochiton*.

PUCCINIA ARTHRAXONIS H. & P. Sydow & Butl. in Annls mycol. 5: 499 (1907).

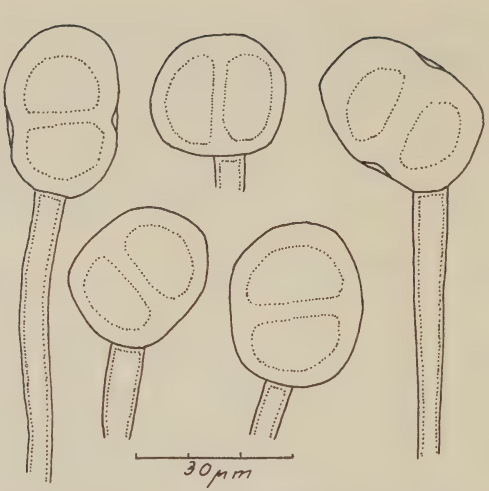

Fig. 1. Puccinia apochitonis sp.nov. Teliospores from type.

On Arthraxon prionodes (Steud.) Dandy (syn. A. serrulatus Hochst.)
Ethiopia. Eritrea, Haichello Kokob, N of Acrour, 1600 m, 19.03.1892, G. Schweinfurth & D. Riva (1091), II.

This rust is previously reported from Eritrea on the same host (Cummins 1953), but not from other places in Africa. In Asia it is known from Pakistan to China and Taiwan.

PUCCINIA ARTHRAXONIS-CILIARIS Cumm. in Uredineana 4: 16 (1953).
On Arthraxon antisiralensis A. Camus
Madagascar. Betafo, 05.1962, J. Bosser (223), II.
On Arthraxon hispidus (Thunb.) Makino (syn. A. mauritianus Stapf ex C. E. Hubbard)
Mauritius. Mount Pouce, 30.04.1976, M.J.E. Coode (5110), II.
On Arthraxon micans (Nees) Hochst. (syn. A. quartinianus (A. Rich.) Nash)
Ethiopia. Kaffa, Bonga, 1750 m, 13.01.1973, I. Friis et al. (2262), II.
Uganda. Toro, Bwamba Pass, 1800 m, 16.11.1935, A.S. Thomas (1424), II.
Malawi. Between Kondowe and Karonga, 1896, A. Whyte, II + III; Misuku, 28.06.1951, G. Jackson (563), II.
Burundi. Bururi Prov., 06.1977, M. Reekmans (6300), II.
Zaire. Albert National Park, 08.1937, Louis (4815), II; Lumumbashi, Kakanga, 29.04.1963, S. Lisowski (645), II; between Kahungo and Thsibinda, 1928, Scaetta (1215), II.
Cameroon. Dschang near Bambouto, 10.11.1965, A. Meurillon (71), II; 10 miles from Ndop on Bamenda road, 20.12.1932,

A.H. Borghey (10479), II.

In Africa P. arthraxonis-ciliaris is previously reported from Ethiopia, Uganda, and Mauritius. In Asia it is known from India and Nepal to China, Japan and the Far East of Siberia, and it is also reported from New Guinea. A. antisiralensis is a new host for this rust species.

PUCCINIA BRACHYPODII Otth var. POAE-NEMORALIS (Otth) Cumm. & H.C. Greene in Mycologia 58: 705, 1966.
On Festuca griffithiana (St.-Yves) Krivot.
Afghanistan. Baghlan Prov., Salang Pass, Khinjan Tal, 2500 m, 27.06.1965, D. Podlech (11563), II, (det. R.W.G. Dennis).

This host seems to be new to this rust. It is previously reported from Afghanistan on Alopecurus sp. and Poa sp.

PUCCINIA CACAO McAlp. in Rusts of Australia p. 117 (1906).
On Hemarthria altissima (Poir.) Stapf & C.E. Hubbard (syn. H. fasciculata (Lam.) Kunth)
Mozambique. Sul do Save, Maputo, 13.04.1946, M. Myre & A. Balsanhas (577), II; Niassa distr., 18.03.1964, A.R. Torres & J. Palva (10065), II.
Tanzania. Rusuende, 09.02.1966, B.D. Nicholson (89), II.
Zambia. Luzaka Prov., 1130 m, 04.01.1973, J. Kornas (2939), II.
Malawi. Karonga, 26.06.1951, J. Jackson (549), II.
Zimbabwe. Shangani distr., Gurampa forest reserve, 01.1956, B. Goldsmith (13), II.

H. altissima has previously been reported as a host for P. cacao in the Canary Islands and Argentina. Another African host is Rottboellia cochinchinensis (Lour.) W.D. Clayton (syn. R. exaltata L.f.). The rust is also known from Pakistan, China, Japan, Taiwan and Australia. Its aecidial stage (Aecidium manilense Arth.& Cumm.) occurs on Hygrophila spp. (Acanthaceae) and is reported from India, Bangladesh and the Philippines. Angus (1966) reported it from Zambia on an unidentified host, probably belonging to Lamiaceae.

PUCCINIA CHASEANA Arth. & Fromme in Torreya 15: 264 (1915).
On Anthephora cristata (Doell) Hack. ex De Wild. & Dur.
Togo. Cacaveli, 06.09.1976, H. Ern et al. (294), II + III.
On Anthephora pubescens Nees
Botswana. 228 miles NW of Molopolole, 19.06.1955, Story (4935), II (+ III).
On Anthephora schinzii Hack.
Namibia. Grootfontain distr., 11.9 miles SE of Namutoni, 28.03.1955, B. de Winter (2958), II + III.
On Anthephora truncata Robyns
Zaire. Katanga, 19.03.1971, M. Lukuesa (1017), III.

P. chaseana has previously been reported twice from Africa, viz. on A. truncata from Tanzania (Gjærum 1983) and on A. ampullacea from Nigeria (Eboh 1985). Elsewhere it is reported scattered from the Caribbean to Guatemala and Colombia. Except for *A. truncata* the hosts mentioned above are new to this rust species.

PUCCINIA CHLORIDIS Speg. in Rev. Argent. Hist. Nat. Buenos Aires 1: 172 (1891).
On *Chloris gayana* Kunth
Tanzania. On the Dodoma road, 42 miles from Iringa, 1500 m, 25.07.1933, P.J. Greenway (3387), (II +) III.
Nigeria. N Kalkala, SW of Lake Chad, 1933, F. Golding (76), (II +) III.
On *Chloris pycnothrix* Swartz
Nigeria. Tiba plateau, Adamawa, 10.12.1965, K. Peters & P. Tuley (70), (II +) III.
On *Chloris virgata* Swartz
Mozambique. Lower Shiré River, 05.1861, C.S. Meller, III.

This rust has previously been reported from Tanzania and Kenya on the two first mentioned hosts, respectively. *C. virgata* is a new host for this rust in Africa, but it has been reported as such from the Dominican Republic and Mexico. In U.S.A. the aecial stage (*Aecidium brandagei* Peck) occurs on *Asclepias* spp. (Asclepiadaceae) and related genera.

PUCCINIA CHRYSOPOGI Barcl. in Asiatic Soc. Bengal J. 58: 247, 1889.
On *Heteropogon contortus* (L.) Roem. & Schult.
Uganda. Karamoja, Mile 6 on Moroto-Kitale road, 05.10.1952, Verdcourt (762), II + III.

H. contortus represents a new host genus for this rust, previously reported only from Pakistan, India and Burma. Other host genera are *Andropogon*, *Chrysopogon*, and *Themeda*. The aecial stage occurs on hosts belonging to Asclepiadaceae and Oleaceae.

PUCCINIA CORONATA Corda in Icon. Fung. 1: 6 (1837), var. CORONATA.
On *Agropyron cristatum* (L.) Gaertn. ssp. *pectinatum* (Bieb.) Tzvelev (syn. *A. pectiniforme* Roem. & Schult.)
Iran. W side of Lake Rezaiyeh, 15.06.1963, M. Jacobs (6912), II.
On *Agrostis lachnantha* Nees
Ethiopia. Asella, 2300 m, 01.11.1965, W. de Wilde (9005), II (+ III).
On *Avena fatua* L.
Kenya. Five miles N of Eldoret, 2100 m, A. Bogdan, II.
On *Helictotrichon elongatum* (A. Rich.) C.E. Hubbard
Sudan. Gilo, Imatong mts, 1850, 08.11.1980, I. Friis & K. Vollesen (4), II.
Tanzania. Ufipa distr., Malonge plateau, 1800 m, 13.03.1959, M. McCallum Webster (92), II; S. Mbulu distr., 2450 m, 02.08.1946, P.J. Greenway (7672), II.
Malawi. Kasaramba, Nyika plateau, 14.04.1951, G. Jackson (508), II.
Cameroon. Bafut-Ngembe forest reserve, Bamenda division, 2150 m, 27.03.1958, F.N. Hepper (2243), II.
On *Helictotrichon milanjianum* (Rendle) C.E. Hubbard

Kenya. Mt Kenya National Park, 2740 m, 05.03.1974, G. Davidse (7022), II.
Uganda. Lake Bunyonyi, Kashenji, 2100 m, 27.11.1935, H.B. Johnston (1356A), II.
Zaire. Upper Ruamoli river, Kivu, 3700 m, 03.08.1952, R. Ross (770), II.
On H. turgidulum (Stapf) Schweick
S. Africa. Orange Free State, 33 km SW of Witsieshoek, 25.02.1974, G. Davidse (6967), II.
On Lolium multiflorum Lam. x perenne L.
S. Africa. Eastern Cape Prov., Grahamstown, 700 m, 08.11.1981, A. Jordt Guillarmod (8911), II.
On Polypogon monspeliensis (L.) Desf.
Cyprus. Morphou, 14.05.1972, W.R. Price (1050), II.
Kenya. Northern Frontier Prov., Marsabit distr., Mt Kulal, 1900 m, 09.10.1947, P. Bally (5547), II.
Tanzania. Northern Prov., Lohondo, 1600 m, 09.11.1953, R. Tanner, II; Musoma distr., Klein's Camp, 1650 m, 23.05.1962, P.J. Greenway (10657), II.
On Polypogon viridis (Gouan) Breistr. (syn. P. semiverticillatus (Forssk.) Hyl.)
Egypt. Bahr el Shibirm, Bilbeis, 28.10.1928, N.D. Simpson (5927), II.
Ethiopia. Eritrea, Saganeiti, Marakhat valley 08.03.1892, G. Schweinfurth & D. Riva (838), II.

The circumglobal crown rust occurs in Africa on many host genera from the Mediterranean area to S. Africa. A. lachnantha and A. turgidulum are new hosts for this rust, and P. elongatus is a new host for the continent, previously reported only from the Canary Islands. A. cristatum is a new host for this rust in Iran. The aecial stage on Rhamnus spp. (Rhamnaceae) has been reported from Morocco and Ethiopia.

PUCCINIA DIETELII Sacc. & Sydow in Saccardo Syll. Fung. 14: 358 (1899).
On Chloris amethystea Hochst.
Kenya. Athi river station, 24.08.1947, A. Bogdan (1119), II + III.
On Chloris gayana Kunth
Kenya. Kitale, 14.04.1964, A. Bogdan (5678), II.
Tanzania. Dodoma road, 42 miles from Iringa, 1500 m, 25.07.1933, P.J. Greenway (3387), (II +) III.
Zambia. Kafue flats, W of Masabuka, 13.05.1957, A. Angus (1586), (II +) III.
Zimbabwe. Matopos, 06.04.1951, D. West (3217), (II +) III.
On Chloris pilosa Schumach. (syn. C. breviseta Benth.)
Sudan. Nuba mts, Abu Kershola, Tiera, 10.11.1981, G.E. Wickens (818), (II +) III; Darfur, Kulme, 1100 m, 09.1921, H. Lynes (521), III.
Zaire. Wombali (Kasai), 10.1913, Vanderyst (2285), II.
On Chloris pycnothrix Trin.
Ethiopia. Lake Tana, Bahadur Gorges, 01.01.1921, G.W. Graham (6), (II +) III.
Nigeria. Vom, 09.-10.1960, M.E. Gambles (8), III.

On *Chloris virgata* Swartz
Uganda. Busoga distr., Jinja, 18.09.1929, Hitchcock (24954), (II +) III.
Tanzania. Iringa distr., Ruaha National Park, Mpululu 22.05.1968, S.A. Renvoize & R.A. Abdallah (2338), (II +) III; Sigi, 370 m, 12.07.19?, P.J. Greenway (762), II; Monik plateau W wall of Rift valley, above Lake Natron, 900 m, 23.07.1962, J.B. Newbould (6206), (II +) III.
Mozambique. Lesiria do Limpopo, Sul do Save, Maniquenque, Guija, 08.07.1948, M. Myre (52), (II +) III.
Malawi. Lilongwe, 23.04.1951, G. Jackson (468), (II +) III.

P. dietelii is widespread in the Americas and in Africa, and it has also been reported from Nepal. *C. amethystea* is a new host species for this rust which has been found on several *Chloris* species. In Tchad it has also been found on *Dactyloctenium aegypticum* (L) Beauv. A record from Zambia on *Andropogon gayanus* Kunth might be doubtful (cf. Gjærum 1983). Cummins (1963) proved its aecial stage to be on *Acalypha* spp. (Euphorbiaceae).

PUCCINIA DIGITARIAE-VELUTINAE Vien.-Bourg. in Bull. Soc. Mycol. Fr. 67: 431 (1951).
On *Digitaria perrottetii* (Kunth) Stapf
Tanzania. Mbula mts, 1 1/2 miles NE of Magugu, 15.04.1964, J.R. Welch, II + III.

P. digitariae-velutinae has been found on several *Digitaria* spp. in Ethiopia, Kenya, Uganda, Tanzania, Nigeria and Ivory Coast, in Uganda also on *Rhynchelytrum repens* (Willd.) C.E. Hubbard. *D. perrottetii* is a new host for this rust.

PUCCINIA DUTHIAE Ell. & Tracy in Ellis & Everhart, Bull. Torrey Bot. Club 24: 283, 1987.
On *Andropogon gayanus* Kunth var. *polycladus* (Hack.) W.D. Clayton (syn. var. *squamulatus* (Hochst.) Stapf)
Zambia. S of Kafue, 22.04.1956, A. Angus (1240), II.
On *Andropogon macrolepis* Hook.
Angola. Between Kutere and Sobi near Knito, 1200 m, 12.03.1900, Kunene-Sambesi Expedition, II.
On *Hyperthelia dissoluta* (Steud.) W.D. Clayton
Ethiopia. Aghere mariam (Alghe), 1900 m, 30.11.1952, J.B. Gillett (14521), II + III.
Tanzania. Kigoma distr., Kibwesa, Mahali mts, 760 m, 11.08.1958, J. Newbould & I.G. Jefford (1639), II (+ III).
Zambia. Lusaka 06.1964, C.A. Smith, II + III.
Zimbabwe. Gwelo, 30.03.1967, H.M. Biegel (1988), II.
S. Africa. Transvaal, Pietermaritzburg distr., Pusela, 25.05.1945, B. Jewaskiewitz, II + III.

In Africa *P. duthiae* has been reported on *Bothriochloa* spp. and *Chrysopogon serrulatus* Trin. The hosts mentioned above are all new to this rust, *Hyperthelia* represents a new host genus. The aecial stage (*Aecidium barleriae* Doidge) occurs on *Barleria* spp. (Acanthaceae), reported from Zambia and Zimbabwe, and also from India.

PUCCINIA ERITRAEENSIS Paz. in Bot. Jahrb. 17: 14 (1893).
On *Andropogon gayanus* Kunth var. *polycladus* (Hack.) W.D. Clayton (syn. var. *squamulatus* (Hochst.) Stapf)
Nigeria. Jos plateau, Gindiri, 24.10.1957, F.N. Hepper (1142), II.
On *Andropogon chinensis* (Nees) Merr. (syn. *A. ascinodis* C.B.Cl.)
Kenya. Machahos distr., near Simba, 07.04.1978, Verdcourt (5239), II.
Tanzania. Masai distr., 07.07.1965, Leippert (5988), II + III; Iringa College, 18.04.1972, C. Pedersen (946), (II +) III.
On *Diheteropogon amplectens* (Nees) W.D. Clayton (syn. *Andropogon amplectens* Nees)
Malawi. Nehisi mt, 1400, 24.07.1946, L.S. Brass (16917), II.

P. eritraeensis is widespread in Africa, and it is also known from China, Spain (Mallorca), Australia and Honduras occurring on several host genera of which *Andropogon*, *Cymbopogon* and *Hyparrhenia* are the main ones. The three hosts mentioned have been reported only once from Sudan, Kenya and Zambia, respectively.

PUCCINIA FACETA H. Syd. in Annls mycol. 32: 289, 1934.
On *Olyra latifolia* L.
Mozambique. Lusite valley, Mossovizi, 24.02.1907, coll. not given, II (det. G.B. Cummins).

Up to now *P. faceta* has been reported only from Brazil, occurring on *O. heliconia* Lindm.

PUCCINIA GRAMINIS Pers. subsp. GRAMINICOLA Urban in Česka Mycol. 21: 14 (1967).
On *Poa leptoclada* A. Rich.
Uganda. Mt Moroto, 05.1963, J. Wilson, II + III (det. R.W.G. Dennis).
On *Polypogon tenuis* Brongn.
S. Africa. Shore between Lourens and Erste rivers, Stellenbosch, 21.05.1946, R.N. Parker (4060) (II +) III.

Polypogon tenuis represents a new host genus for this circumglobal stem rust in Africa, and both hosts mentioned are new for this rust. The aecial stage of *P. graminis* s.lat. (*Aecidium berberidis* Pers.) has been reported on *Berberis hispanica* Boiss. & Reut. (Berberidaceae) from Algeria and Morocco.

PUCCINIA HORDEI Otth in Mitt. Naturf. Ges. Bern 1870: 114 (1871).
On *Avena parviflora* Desf. (syn. *Trisetaria parviflorum* (Desf.) Maire)
Algeria. Bou Hamra near Bone, 21.05.1865, Dukesley (550), III (det. R.W.G. Dennis); Constantine Prov., Beni Bou-Jousef, 27.06.1880, E. Cosson, II + III.
On *Bromus pectinatus* Thunb. (syn. *B. japonicus* Thunb.)
S. Africa. Cape Prov., Graaff Reinet distr., Blue Gum farm, 14.10.1983, Retief & Reid (563), II + III.
On *Holcus lanatus* L.

Turkey. Soganli Pass, Trabson, 1500 m, 16.08.1986, P. Jarse (3935), II (+ III).
On *Hordeum marinum* Huds. subsp. *marinum*
Iraq. Baguba, 15.05.1961, Hadač et al. (1953), II + III.
On *Puccinellia anisoclada* V. Krecz.
Afghanistan. Ghorat Prov., 17.3 miles W of Chagcharan, on banks of Hari Reed, 2150 m, 20.06.1971, C. Gray Wilson and T.F. Hewer (1174), II + III.
On *Trisetaria canariense* (Parl.) Pign. (syn. *T. neglecta Trisetum canariense*)
Canary Islands. Gran Canaria, Monte, 05.1894, R.M. Murray, III.
On *Trisetum flavescens* (L.) Beauv.
U.S.S.R. Turkmenia, Yugo-zapadni Bakhardensk rayon, Kesse Iola, Kopetdag, 1000 m, 04.06.1974, V.V. Nikitin & A. Ivanov, (II +) III.
Iran. Gorgan, 21.05.1948, Scharif (8055E) (II +) III.
Turkey. Bitlis Prov., Tatvan, 1750 m, 27.06.1954, Davis (22187), II.

In his monograph Cummins (1971) listed numerous synonyms and recognized *P. hordei* as a "complex" species. *Puccinellia anisoclada* represents a new host genus and *A. parviflora*, *B. pectinatus* and *H. marinum* are new hosts for this rust. *H. lanatus* and *T. canariense* are new hosts for the rust in Turkey and the Canary Islands, respectively.

The aecial stage occurs on *Allium* and *Ornithogalum* (Liliaceae) and on *Sedum* (Crassulaceae), and it is reported from Morocco on *Ornithogalum umbellatum* L.

PUCCINIA LEPTURI Hirats.f. in Trans. Sapporo Nat. Hist. Soc. 17: 28 (1941).
On *Lepturus radicans* (Steud.) A. Camus
Kenya. Diana Beach, 06.07.1960, D. Napper (1665), II.
On *Lepturus repens* (G. Forster) R. Br.
Phoenix Islands. Enderbury Island, 31.05.1973, F.R. Fosberg & D.R. Stoddard (54730), II.

P. lepturi is previously reported only on *L. repens* from Ryukyu Islands.

PUCCINIA MAGNUSIANA Koern. in Hedwigia 15: 179 (1876).
On *Phragmites australis* (Cav.) Steud. (syn. *P. communis* Trin.)
U.S.S.R. W Siberia, near Tjumen, 07.1915, S. Mameev (70), (II +) III.
Turkey. Antalya distr., Karagol, Elmali, 07.08.1947, P.H. Davis (13908), III.
Cyprus. Nicosia 03.10.1955, M. Pallis, II.
Oman. Dhofar, Taquah, E of Salalah, 25.11.1981, J.R. Maconochie (2977), II.
Tunisia. Ishkeul National Park, 1978-79, J.M. Fay (830), II.
S. Africa. Orange Free State, Bloemfontein, 06.06.1917, G. Potts (2390), (II +) III; Idas valley, Stellenbosch, 11.04.1920, S. Garside (1378), (II +) III; Western Reg., Genadendal, 05.04.1897, M. Schlechter 10330, II + III.
On *Phragmites mauritianus* Kunth

S. Africa. Transvaal, 28.08.1928, M.E. Blankman (436), II.

This circumglobal rust species has been reported from many countries in Africa, mainly on P. australis but also on P. mauritianus. It is new to the rust flora of Turkey and Oman. The aecial stage which occur on species of Anemone, Clematis and Ranunculus (Ranunculaceae) has not been reported from Africa.

PUCCINIA NAKANISHIKII Diet. in Bot. Jahrb. 34: 585, 1905.
On Cymbopogon giganteus (Hochst.) Chiov.
Mozambique. Mozambique distr., Malema, 28.04.1961, A. Balsenhas & L. Marrime (467), II.

P. nakanishikii, occurring on several graminicolous genera and species, especially on Cymbopogon spp., is widespread in Asia from Pakistan to Japan, and on islands in the Pacific Ocean. In Africa it has been reported from Libya, Uganda, Zaire and Madagascar. C. giganteus is a new host for this rust species.

PUCCINIA POLYPOGONIS Speg. in An. Mus. Nac. B. Aires 19: 300 (1909).
On Polypogon monspeliensis (L.) Desf.
S. Africa. Cape Town, Melkbosstrand, 19.10.1980, A.O. Crook, II; Cape Prov., shore at the mouth of R. Unjab, Kakaoveld, 13.11.1961, D. Giess (3923), II + III, and Vredenberg distr., Paternoster, 14.10.1959, H.J. van Rensburg (124), II + III; near Saron, 10.1896, M. Schlechter (10032), II + III.

Jørstad (1956) also reported this rust on the same host from Saron in the Cape Prov., the only African record up to now. It has been published from Argentina, Brazil and Uruguay and also from Iraq. P. monspeliensis is the type host.

PUCCINIA RECONDITA Rob. ex Desm. in Bull. Soc. Bot. Fr. 4: 798 (1857).
On Agrostis gigantea Roth
Iran. Kalardasht, 1500 m, 20.08.1960, F.W. Sheard (E 4), II.
On Agrostis lachnantha Nees
Malawi. Northern Prov., Nyika plateau, Chelinda Camp, 2200 m, 26.10.1958, N.K.B. Robson (378) II (+ III)
On Bromus diandrus Roth
S. Africa. Cape Prov., Barenskop between Malmesbury and Hopefield, 24.09.1969, M.P. Fourie, II.
On Bromus hordeaceus L. (syn. B. molliformis Lloyd)
S. Africa. Cape Prov., Malgas, Potberg, 12.10.1981, L. Smook (3732), II.
On Bromus leptocladus Nees
Kenya. Aberdare forest, 10 miles NE of Kijabe, 2500 m, 16.10.1949, A. Bogdan (2646), II (+ III).
Tanzania. Mbeya mts, 2380 m, 13.05.1956, E. Milne-Redhead & P. Taylor (10334), II + III.

P. recondita includes several specialized forms, often recognized as species, occurring on many genera in Poaceae. To my knowledge this rust has not previously been reported from the African continent on *Agrostis*, but it has been reported from Madeira on *A. castellanea* Boiss. & Reut. (Torrend 1912, as *P. agrostidis* Plowr.). *A. lachnantha* is a new host for this rust. The aecial stage on *Aquilegia* (Ranunculaceae) has not been recorded in Africa. *A. gigantea* is a new host for this rust in Iran.

P. recondita (often as *P. bromina* Eriks.) has been reported on a large number of *Bromus* spp. from Morocco, Algeria, Egypt, Ethiopia, Kenya, Uganda and Malawi, and also from S. Africa. *B. diandrus* is a new host in the African continent, previously recorded only from the Azores (Gjærum & Hansen 1986) while *B. hordeaceus* has been reported from Tanzania and the Canary Islands and *B. leptocladus* from Uganda only (Gjærum 1983).

The aecial stage on boraginaceous hosts has been reported from Morocco.

PUCCINIA SESSILIS W.G. Schneider in Schroeter, Abh. Schles. Nat. Abth. 1869-72: 19, 1870, var. SESSILIS.
On *Phalaris arundinacea* L.
Kenya. Thika distr., Chania river, 21.03.1959, P.J. Greenway (9564), II; 10 miles N of Gilgil, 2400 m, 08.12.1948, A. Bogdan (2159), II.

This rust is widespread in Europe, in U.S.S.R., China and Japan, and also in U.S.A. and Canada. Hitherto it has not been reported from Africa. *Phalaris* is the main host genus, but it occurs also on *Festuca*. The aecial stage (*Aecidium majanthae* Schum.) occurs on numerous species belonging to Araceae, Iridaceae, Liliaceae and Orchidaceae.

PUCCINIA STRIIFORMIS Westend. in Bull. Roy. Acad. Belg., Cl. Sci. 21: 235 (1854) var. STRIIFORMIS.
On *Bromus pectinatus* Thunb. (syn. *B. adoensis* Steud.)
S. Africa. Cape Prov., Greifswald, 1913, no coll. given, II.

The stripe rust in Africa is common especially on cereals, but also on grasses from Morocco, Algeria, Libya and Egypt south to Tanzania and Zambia. On *Bromus* it is reported on *B. lanceolatus* Roth (syn. *B. macrostachys* Desf.), *B. rigidus* Roth and *B. squarrosus* L. from Morocco, on *B. rigidus* also from the Canary Islands. *B. pectinatus* is a new host for this rust.

PUCCINIA TRACHYPOGONICOLA sp.nov. (Fig. 2)

Aecidia et uredinia ignoti. Urediniosporae in teliis intermixtae, paraphyses geniculatae. Urediniosporae 24-38 x 20-33 µm, ellipsoideae, subgloboideae vel irregulares, pariete basi 3 µm crasso, laterali 1.5-2.5 µm crasso, ad apicem usque 3 µm incrassato, castaneo, echinulato, 3-5 poris dispersis instructis. Telia linearia in vagina et in pagina abaxiali foliorum, exposita, pulvinata, fusca. Teliosporae 30-62 x 13-22(-27) µm, fusiformes vel ellipsoideae, irregulares vel geniculatae, ad septum constrictae, pariete 1 µm crasso, ad apicem usque 11 µm incrassato, pallide cinnamomeo vel cinnamomeo, laevi, poro supe-

riore apicali, poro inferiore obscuro, pedicello hyalino, minus quam 15 um longo.
Holotype: M. Reekmans 9196 (K), Burundi, Bururi Prov., Gihofi, 1300 m, 20.05.1980 on *Trachypogon chevalieri* (Stapf) Jac.-Fél. Isotype in NPPI.

Cummins (1971) listed two species on *Trachypogon*, viz. *Puccinia eritraeensis* Paz. and *P. versicolor* Diet. & Holw. This new species differs from the former in having a less number of pores in the urediniospores and longer teliospores with a thinner wall and a more thickened apex. From the latter species it differs in having paraphyses in the uredinia and urediniospores with an evenly thick wall, not stellate as in the latter one.

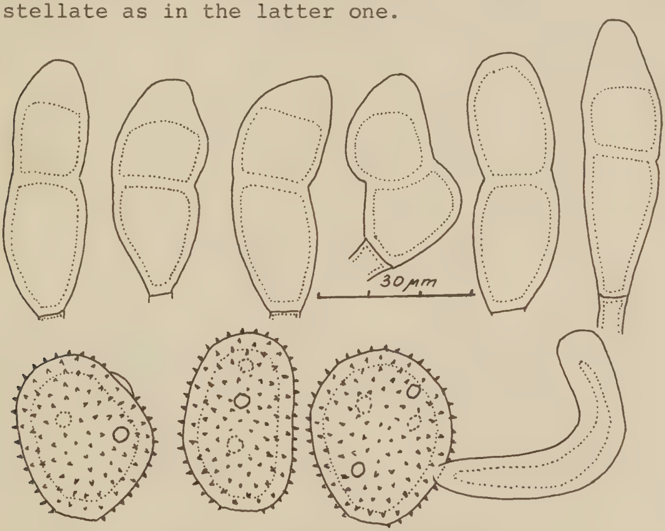

Fig. 2. *Puccinia trachypogonicola* sp. nov. Telio- and urediniospores and paraphysis from type.

PUCCINIA TRICHOPTERYGICOLA sp.nov. (Fig. 3)

Aecidia ignota. Uredinia in pagina abaxiali foliorum, brunnea, cum paraphysibus capitatis vel capitatis-clavatis, usque 70 µm longis, capitulis 14-16 µm lateralis, pariete ad apicem usque 5.5 µm crasso, hyalino. Urediniosporae 20-23 x 19-23 µm, subgloboideae vel globoideae, pariete 1 µm crasso, castaneo, dense echinulato, 3-4 poris equatorialibus instructis. Telia amphigena, exposita, pulvinata, fusca. Teliosporae 33-42 x 22-30(-33) µm, ellipsoideae, ad septum non vel leniter constrictae, pariete 2-4 µm crasso, ad apicem usque 5.5 µm incrassato, cinnamomeo vel castaneo, laevi, poro superiore apicali, poro inferiore obscuro, pedicello hyalino, usque 150 µm longo.
Holotype: M. McCallum Webster A 349 (K), Zambia, Abercorn

distr., Kalumbo falls, 1200 m, 21.04.1959, on *Trichopteryx fruticulosa* Chiov. Isotype in NPPI.

Cummins (1971) listed no rust on *Trichopteryx*. However, Wakefield & Hansford (in Hansford 1938) described *Puccinia trichopterygis* on *T. afroflammida* (an unpublished name for *Loudetia phragmitoides*) and *T. arundinacea* (A. Rich.) Engl. (= *Loudetia arundinacea* (A. Rich.) Steud.) but as this was a nomen nudum they (Wakefield & Hansford 1949) described the same specimen as *P. loudetiae* now on *Loudetia phragmitoides* (Peter) C.E. Hubbard (= *L. flammida* (Triv.) C.E. Hubbard).

P. trichopterygicola differs from *P. trichopterygiphila* Gjærum having wider teliospores with thicker wall and longer pedicel.

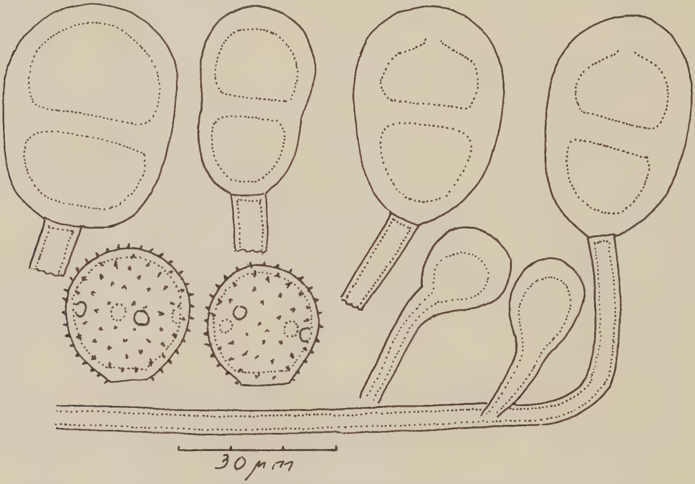

Fig. 3. *Puccinia trichopterygicola* sp.nov. Telio- and urediniospores and paraphyses from type.

PUCCINIA TRICOPTERYGIPHILA sp.nov. (Fig. 4)

Aecidia et uredinia ignota. Telia amphigena, pro maxima parte in pagina abaxiali, lineares, exposita, pulvinata, fusca. Teliosporae 25-36 x 14-21 μm, obovoideae, clavatae vel irregulares, saepe ad apicem truncatae, ad septum constrictae, pariete 1 μm crasso, ad apicem usque 2.5 μm incrassato, apice castaneo, ad basem pallidiore, laevi, pedicello hyalino, usque 15 μm longo. Holotype: G. Jackson 1869 (K), Malawi, Mlanje distr., Tuchila river valley 12.07.1956 on *Trichopteryx fruticulosa* Chiov. Isotype in NPPI.

Teliospores not unlike the two-celled spores in *P. hordei* Otth, but they occur in long streaks without paraphyses. One-celled teliospores are not seen. *P. trichopterygiphila* differs from *P. trichopterygicola* Gjærum in

having more narrow teliospores with thinner wall.

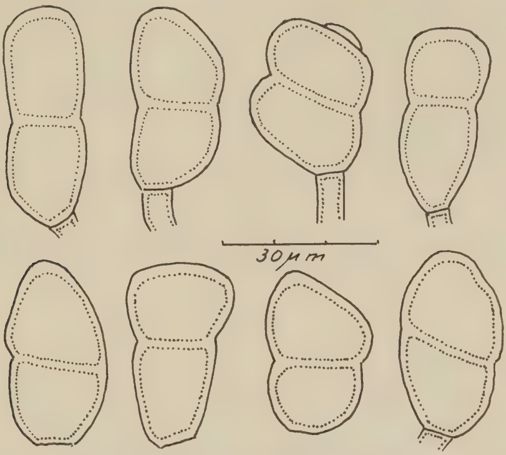

Fig. 4. Puccinia trichopterygiphila sp.nov.
Teliospores from type.

PUCCINIA TRIRAPHIDIS sp. nov. (Fig. 5)

Aecidia et uredinia ignota. Telia in pagina abaxiali foliorum, exposita, pulvinata, fusca. Teliosporae 33-45 x 23-29 µm, ellipsoideae, basi raro contractae, pariete luteo-brunneo, in laterali cellulae inferioris 3-4 µm crasso, cellulae superioris 4-4.5 µm, ad apicem usque 8.5 µm incrassato, laevi, pedicello luteolo, persistente, collabente, usque 125 µm longo.

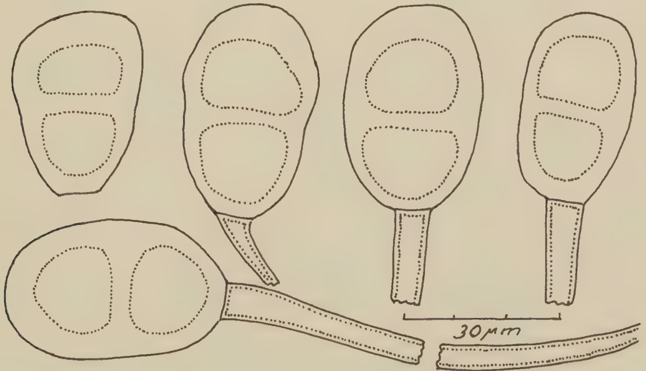

Fig. 5. Puccinia triraphidis sp.nov.
Teliospores from type.

Holotype: B.K. Simon 2166 (K). Zimbabwe, Wankie distr., Kazuma range, 1000 m, 09.05.1972, on Triraphis schinzii Hack. Isotype in NPPI.

No rust has previously been described on Triraphis.

PUCCINIA UNICA Holw. var. BOTTOMLEYAE (Doidge) Cumm. & Husain in Bull. Torrey Bot. Club 93: 60, 1966.
On Aristida adscensionis L.
Saudi Arabia. Near head of Grandi Lavori road, 5 km S of Baljarshi, 2100 m, 17.09.1982, J.S. Collenette (3875), II + III.

This rust is new to Saudi Arabia, but it has been reported on the same host from the Canary Islands, Uganda and S. Africa.

PUCCINIA VERSICOLOR Diet. & Holw. in Holway Bot. Gaz. 24: 28 (1897).
On Andropogon gayanus Kunth
Ivory Coast. At Comoe river between Bouna and Ferkenedougou, 04.08.1967, C. Gerling and J. Bokdan (438), II.
On Andropogon gayanus Kunth var. polycladus (Hack.) W.D. Clayton (syn. var. squamulatus (Hochst.) Stapf)
Sudan. N. Kaloki Hiro, Jebel Marra, 1150 m, 15.09.1964, G.E. Wilkens (2569), (II +) III.
Zambia. Lusaka, 09.08.1952, A. Angus (33), II + III.
Nigeria. Toro, 20 miles E of Jos, 1050 m, 11.1949, A.T. Semple (166), II + III; 69 miles from Yola on road to Bia, 10.11.1969, P. Tuley (1842), II + III.
On Cymbopogon giganteus Chiov.
Zaire. Orientale Prov., Bunia, 1300 m, 01.1960, D. Froment (643), II.
On Cymbopogon martinii (Roxb.) Wats.
Comoro Islands. Mayotte, Kombani, 200 m, 13.12.1968, H.J. Schlieben (11317), II.
On Cymbopogon stypticus (Rendle) Fritsch (syn. C. densiflorus (Steud.) Stapf)
Angola. Malange, prior to 1905, J. Gossweiler (808), II.
On Heteropogon contortus (L.) Roem. & Schult.
Tanzania. Songia distr., 2.5 km E of Johannsbruck, 18.04.1956, E. Milne-Redhead & P. Taylor (9761), II.
Zambia. Mumbwa, 1911, Mrs. Mocanlay, II + III.
Ghana. Accra plains, 02.10.1949, J.T. Baldwin (13440), II + III.
São Thomé. Gulf of Guinea, S. Antonio, 06.1885, A. Moller (151), II.
Zimbabwe. Beatrice distr., 15.02.1947, J.M. Rattray (20620), II.
On Heteropogon melanocarpus (Ell.) Benth.
Kenya. Kwale distr., Buda Mafisini forest, 8 miles W of Gazi, 80 m, 21.08.1953, R.B. Drummond & J.H. Hemsley (3949), II + III.
Tanzania. Ulanza distr., Luhombero junc., 450 m, 09.06.1967, A.F. Rees (98), (II +) III.
Mozambique. Sofala e Manica, Beira, 04.06.1956, M. Myre & A. Balsinhas (2354), III, and 20 km N of Dombe, 150 m, 04.06.1971, H.M. Biegel & G.V. Pape (3546), III; Zambesia,

Metalola, Mbobo, 20.04.1943, A.R. Torre (5209), (II +) III.
Zambia. Southern Prov., near Livingstone, 21.03.1963, W.L. Astle (2283), III; Kafue Game Park, Ngoma forest, 11.06.1960, A. Angus (2403), III, Southern Prov., Namwala, 1150 m, 18.04.1963, H.J. van Rensburg (2050), III.
Zimbabwe. Lomagundi distr., 10 miles E of Banket, 24.03.1969, H.M. Biegel (2891), (II +) III; Wankie distr., Matetsi Safari unit, 1000 m, 19.03.1974, P. Gonde (71/74), (II +) III; Nyamandhlova distr., 13.04.1953, D.C.H. Plowes (1099), III.
Botswana. Tsodilo, 02.05.1975, P.A. Smith (1371), III.
On _Ischaemum_ _afrum_ (J.F. Gmel.) Dandy
Kenya. 18 miles SSW of Embu 1100 m, 20.02.1957, A. Bogdan (4432), II (+ III).
Tanzania. Mbulu distr., Mbulumbul, 1530 m, 28.06.1945, P.J. Greenway (7497), II.
Zimbabwe. Beitbridge distr., Lindi valley, 26.04.1972, W.B. Cleghorn (2623), II.
On _Schizachyrium_ _sanguineum_ (Retz.) Alston
S. Africa. Natal, Nkandla forest, 1200 m, 14.10.1964, D. Edwards (3310), and Mtungini distr., Ngoye forest reserve, 02.02.1963, B.J. Huntley (901), both only II.
On _Sehima_ _ischaemoides_ Forssk.
Zimbabwe. Sabung C distr., 04.1953, R.W. Davis (43445), III.
On _Sehima_ _nervosum_ (Bottl.) Stapf
Kenya. Nairobi 27.09.1915, W.J. Dawson (226), II.

In Africa _P. versicolor_ has been reported on several host genera and species in many countries from Sudan to S. Africa. _C. giganteus_, _C. stypticus_, _I. afrum_, _S. sanguineum_ and _S. ischaemoides_ are all new host species. Outside Africa it is known from Pakistan, India, China, Japan, Australia, Papua and New Guinea, and from Texas and Arizona in U.S.A. southward to Argentina. In Africa its aecial stage on _Canthium_ spp. (Rubiaceae) has been reported from the Ivory Coast, Guinea, Nigeria and S. Africa.

UREDO _ELYMANDRAE_ sp. nov. (Fig. 6)

Uredinia in pagina abaxiali foliorum, castanea, cum paraphysibus capitatis vel clavatis, usque ad 55 µm longis, geniculatis, pallide luteolis vel atroluteolis, pariete ad apicem usque 5 µm crasso. Urediniosporae 26-33 x 21-27 µm, ellipsoideae vel lato ellipsoideae, pariete 1-2.5 µm crasso, ad apicem leniter incrassato, cinnamomeo vel atrocinnamomeo, echinulato, (4-)5 poris papillis humilibus tectis equatorialibus instructis.
Holotype: J.M. Fay 5994 (K), Central African Republic, no locality given, 595 m, 21.10.1983 on _Elymandra_ _androphila_ Stapf. Isotype in NPPI.
Other material:
On _Elymandra_ _androphila_ Stapf
Ghana. On Dokrupe road, 6.8 miles from Seripe, 13.10.1959, J.O. Aukrah (20435), II.

To my knowledge no rust has been described on _Elyman-_

dra. The present rust differs from most other rusts in this group (paraphysate and with equatorial pores) on hosts belonging to Andropogonoideae mainly by the geniculate paraphyses. The only exception is Uredo geniculata Cumm., known from the Philippines and New Guinea on Sorghum nitidum (Vahl) Pers., which differs in having spores with more pores, 6-8 versus (4-)5.

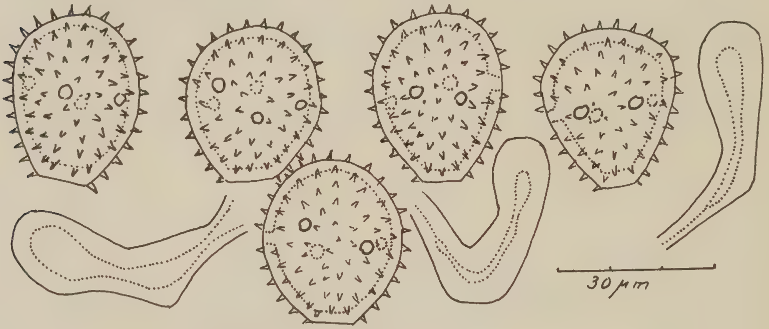

Fig. 6. Uredo elymandrae sp.nov.
Urediniospores and paraphyses from type.

UREDO ERAGROSTIDIPHILA sp. nov. (Fig. 7)

Uredinia amphigena, pro maxima parte in pagina abaxiali, cinnamomea. Urediniosporae 19-24 x 14-18(-20) µm, ellipsoideae vel obovoideae, pariete cinnamomeo, 1-1.5(-2) µm crasso, (3-)4(-5) poris papillis humilibus tectis plus minusve equatorialibus instructis.

Holotype: Liben 425 (K), Zaire, Orientale Prov., Mahagy territory, Gote, 05.11.1952 on Eragrostis kiwuensis Jedw. Isotype in NPPI.

Other material:

On Eragrostis ciliaris (L.) R.Br.

Burundi. Rusizi plain, Bujumbura, 800 m, 05.02.1968 and 13.02.1972, J. Lewalle (2785, 6543), II; Bubanza Prov., S of Kagunuzi river, 1050 m, 14.12.1986, K.A. Lye (12403, NPPI).

Zaire. Stanley Pool, 06.1899, R. Schlechter (12523).

On Eragrostis kiwuensis Jedw.

Ethiopia. Gara Mulata mts, 2650 m, 04.03.1933, J.B. Gillett (5344).

Uganda. Kigezi, near Lake Bunyonyi, 1950 m, 13.10.1929, J.D. Snowden (1447), and Maziba, 2100 m, 12.1944, J.W. Purseglove (1621); Kudan mt 2850 m, 04.1959, J. Wilson (756).

Tanzania. Arusha distr., Mt Meru, 1800 m, 28.05.1968, S.A. Renvoize (2427) and Tue crater, Mt. Meru, E side, 2500 m, 23.04.1968, P.J. Greenway & Kanusi (13516).

Zaire. N. Kivu, Kikomero, Virunga vulcano, 1770 m, 20.09.1954, H.U. Stauffer (439; Matumbe terr., Lubero, 2200 m, 03.09.1959, A. Leonard (5386, C.).

On Eragrostis racemosa (Thunb.) Steud.

Zaire. Mutahapa road, 1800 m, 20.05.1947, Eaton (480).
On Eragrostis schweinfurthii Chiov.
Sudan. Imatong mts, Gilo, 1850, 08.11.1980, I. Friis & K. Vollesen (38, C).

Two specimens on E. kiwiensis from Kigezi in Uganda published as Uromyces eragrostidis Tracy by Wakefield & Hansford (1949) and as Uredo sp. by Gjærum (1983) belong here.

This species differs from Uromyces eragrostidis Tracy and Puccinia eragrostidis Petch having smaller spores with a lower number of pores.

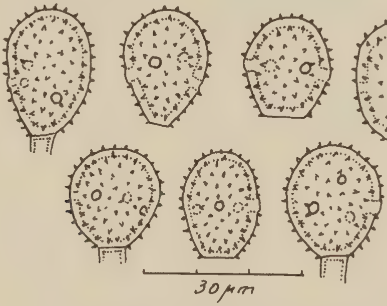

Fig. 7. Uredo eragrostidiphila sp.nov. Urediniospores from type.

UREDO ERAGROSTIDIS-CAPENSIS sp. nov. (Fig. 8)

Uredinia amphigena, cinnamomea. Urediniosporae 25-35 x 25-34 µm, subgloboideae, pariete 2.5-3 µm crasso, aureo vel cinnamomeo, echinulato, (5-)6-7(-8) poris papillis humilibus tectis dispersis instructis.
Holotype: H.P. van der Schijff 5988 (K), S. Africa, E. Transvaal, Mariepskop, 08.01.1962 on Eragrostis capensis

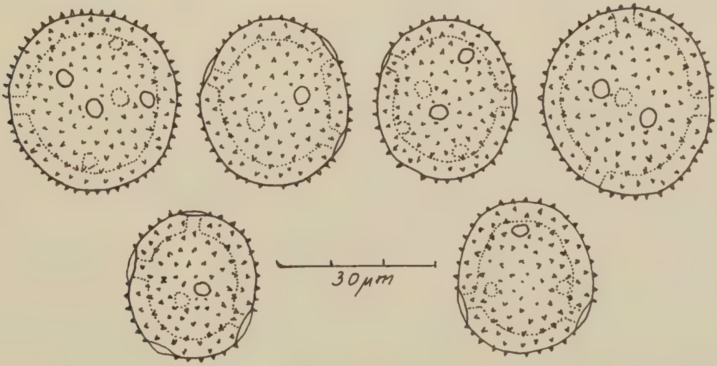

Fig. 8. Uredo eragrostidis-capensis sp.nov. Urediniospores from type.

(Thunb.) Trin. Isotype in NPPI.

The urediniospores are more globoid and have a thicker and more closely and finely echinulate wall than other species occurring in Eragrostis.

UREDO LEERSIAE sp.nov. (Fig. 9)

Uredinia amphigena, pro maxima parte in pagina abaxiali foliorum, cinnamomea. Urediniosporae (20-)25-43 x 24-35 µm, ellipsoideae, obovoideae vel irregularissimae, pariete 1.5-2.5 µm crasso, cinnamomeo, echinulato (2-)3(-4) poris equatorialibus instructis.

Holotype: J.D. Kennedy 8050 (K), Nigeria, Jos dist., Novaguta 09.10.1944 on Leersia hexandra Sw. Isotype in NPPI.

Cummins (1971) listed 6 rust species on Leersia, three of them with equatorial pores, but none of them has so irregular spores as this, many of them triangular.

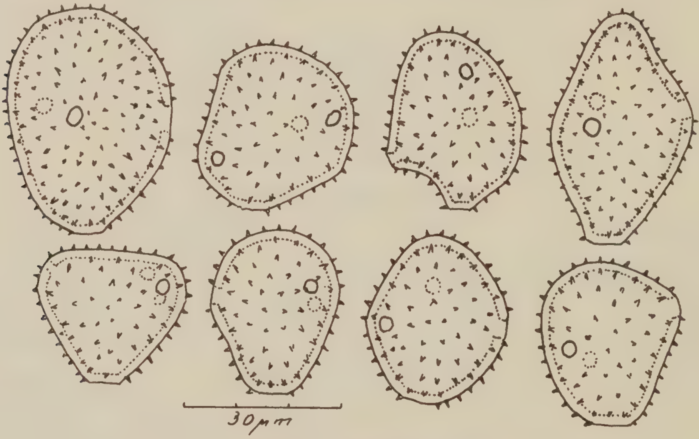

Fig. 9. Uredo leersiae sp.nov.
Urediniospores from type.

UREDO TRICHOPTERYGIS-DREGEANAE sp.nov (Fig. 10).

Uredinia in pagina abaxiali foliorum, atrocinnamomea. Urediniosporae 23-32 x 18-26(-29) µm, subgloboideae, ellipsoideae vel obovoideae, interdum latiores quam longae, pariete 1-1.5 µm crasso, cinnamomeo, echinulato praeter circum duos poros equatorios.

Holotype: I.B. Pole Evans 3430 or 3438 (K), Swaziland, Mbabane, 21.05.1932, on Trichopteryx dregeana Nees. Isotype in NPPI.

This species has no paraphyses and the urediniospores have only two pores while the uredinia of Puccinia trichopterygicola Gjærum have paraphyses and spores with 3-4 pores. It cannot be said whether this uredinial stage belongs to Puccinia trichopterygiphila Gjærum or not as no uredinial stage is known for this species.

In the grass rusts uredinia with 2 equatorial pores are rare. Cummins (1971) listed the following species: Puccinia kiusiana Hirats. f., P. erianthicola Cumm. and three varieties of P. levis (Sacc. & Bizz.) Magn., viz. var. levis, var. goyazensis (P. Henn.) Ramachar & Cumm., and var. tricholaenae (H. & P. Syd.) T. & K. Ramakr. The two species P. advena H. Syd. and P. orientalis (H. & P. Syd. & Butl.) Arth. & Cumm. have basal pores. Several species have urediniospores with 2 or 3 equatorial pores.

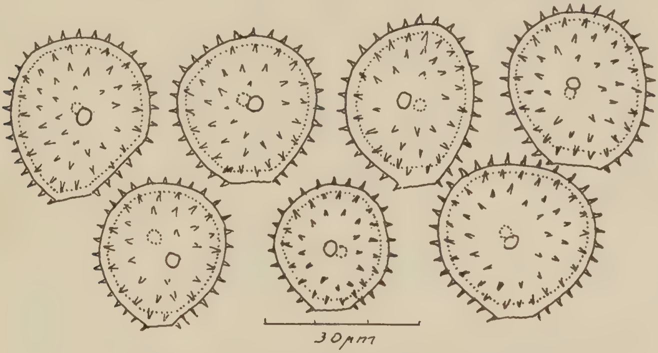

Fig. 10. Uredo trichopterygis-dregeanae sp.nov. Urediniospores from type.

UROMYCES ARCHERIANUS Arth. & Fromme in Torreya 15: 261 (1915).
On Chloris virgata Swartz
Malawi. Zomba, 900 m, 1936, A.B. Cormack (340), III (det. R.W.G. Dennis).

This rust is reported on Chloris spp. from Uganda, S. Africa, Australia, Mexico and USA, and on Enteroporon monostachya (Vahl) K. Schum. from Tanzania. C. virgata is the type host.

UROMYCES CHAETOBROMI sp.nov. (Fig. 11)

Aecidia et uredinia ignota. Urediniosporae in teliis intermixtae, 28-31 x 23-30 µm, ellipsoideae vel subgloboideae, pariete 2.5-3 µm crasso, echinulato aureo, 7-8 poris dispersis obscuris instructis. Telia amphigena, pulvinata, laxe epidermide tectu. Teliosporae 24-35 x 16-27 µm, irregulares, ellipsoideae, angulatae, saepe apicali truncatae, pariete laterali, 1-1.5 µm crasso, ad apicem 8 µm incrassato, castaneo, ad apicem extus pallidior, pedicello collabente, pallide cinnamomeo, usque 45 µm longo.
Holotype: van Breda 4302 (K), S. Africa, Cape Prov., Chanwilliam distr., 07.11.1974 on Chaetobromus schraderi Stapf. Isotype in NPPI.

No rust has previously been reported on Chaetobromus.

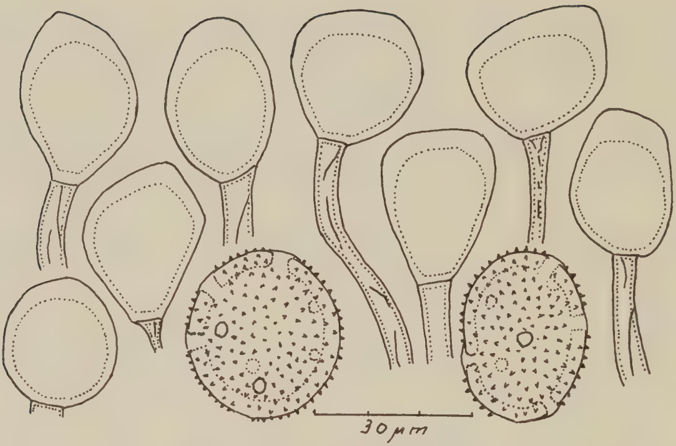

Fig. 11. Uromyces chaetobromi sp.nov.
Telio- and urediniospores from type.

UROMYCES CLIGNYI Pat. & Har. in J. Bot. 14: 237 (1900).
On Andropogon amethystinus Steud. (syn. A. pratensis Hack.)
Kenya. West Kenya, 2200 m, 1923, D.K.S. Grant (1238), II + III; Molo 2700 m, 09.01.1934. no leg., II + III.
Cameroon. Bafat-Ngemba forest reserve, Bamenda, 2100 m, 22.02.1958, F.N. Hepper (2123), II.
S. Africa. Natal, Estcourt distr., 2000 m, 18.02.1969, F.B. Wright 831, II.
On Andropogon schirensis A. Rich.
Zambia. Central Prov., Kundalila Falls, 53 km ENE of Serenje, 1450 m, 04.02.1973, A. Strid (2909), II.
Burundi. Kigwena, Bururi, 800 m, 02.04.1981, M. Reekmans (9917), II (+ III).
On Diheteropogon amplectens (Nees) W.D. Clayton var. catangensis (Chiov.) W.D. Clayton
Malawi. Meno Hills, 1050 m, 02.07.1949, P.O. Wiehe (161), II + III; Mzimba distr., 1350 m, 30.05.1971, Pawek (4677), II.
On Heteropogon contortus (L.) Roem. & Schult.
Uganda. Mt Elgon, Buwalasi, 1500 m, 13.12.1927, J.D. Snowden (1247), II.
On Monocymbium ceresiiforme (Nees) Stapf
Malawi. Zomba plateau, 1800 m, 25.04.1949, P.O. Wiehe (190), II
(+ III).
On Schizachyrium urceolatum (Hack.) Stapf
Ghana. Mole reserve 05.02.1966, Hall & Ente (Gold Coast Herb. No. 35923), III.

Uromyces clignyi has been reported from many countries in Africa and Asia, from some islands in the Pacific Ocean, Australia, Central America, Mexico and from the British West Indies, living on about 15 host genera. Diheteropogon is a new host genus for this rust, A.

amethystinus and S. urceolatum are new hosts and H. contortus is a new host for it in Africa. Species of Chlorophytum (Liliaceae) and Crinum and Cyrthanthus (Amaryllidaceae) have been reported as aecial hosts in Africa.

UROMYCES CLIGNYIOIDES sp. nov. (Fig. 12)

Aecidia ignota. Uredinia in pagina abaxiali foliorum, cinnamomea. Urediniosporae 19-20 x 19-20 µm, globoideae, pariete 1-1.5 µm crasso, hyalino vel pallide luteo, echinulato, 5-6 poris dispersis instructis. Telia in pagina abaxiali foliorum, exposita, pulvinata, atrocinnamomea. Teliosporae 39-43 x 39-44 µm, globoideae, raro complanatis apicalis, pariete base 2.5-3 µm, aliter 4-5.5(-7) µm crasso, flavobrunneo, laevi, pedicello hyalino vel pallide luteo, persistente, collabente, longitudine 30 µm excedente.
Holotype: G. Davidson et al. 6577 (K), Zimbabwe, Inyanga National Park, 2100 m, 12.02.1974 on Monocymbium ceresiforme (Nees) Stapf. Isotype in NPPI.

This rust is similar to U. clignyi Pat. & Har., but differs from this in having smaller urediniospores with less pores and having larger teliospores.

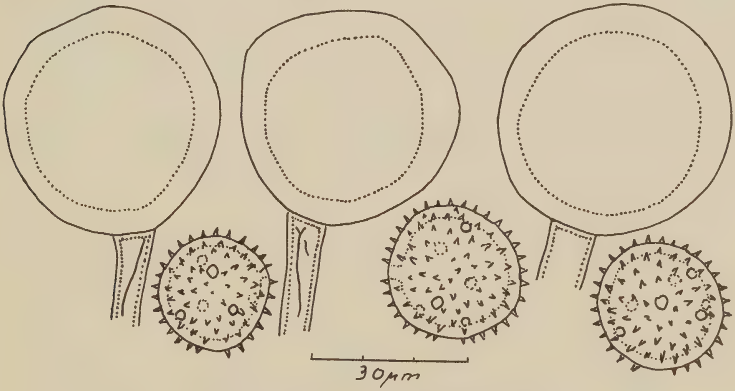

Fig. 12. Uromyces clignyioides sp.nov.
Telio- and urediniospores from type.

UROMYCES DACTYLIDIS Otth var. POAE (Rbh.) Cumm. The rust fungi of cereals, grasses and bamboos p. 474 (1971).
On Trisetum flavescens (L.) Beauv.
Turkey. Giresun Prov., below Tamdere, 1600 m, 09.08.1952, Davis (20638), (II +) III.

T. flavescens was reported from Switzerland by Fischer (1904) as a host for U. ranunculi-distichophylli Semad., later described as U. volkartii by Gäumann & Terrier (1952), under the former name was also reported from Caucasus (Voronikhin 1927). Cummins (1971) made both names synonymous with U. dactylidis var. poae. T. flave-

scens seems to be a new host for this rust in Turkey.

UROMYCES ERAGROSTIDICOLA sp.nov. (Fig. 13)

Aecidia ignota. Uredinia in pagina abaxiali foliorum, cinnamomea. Urediniosporae 20-28 x 19-25 µm, ellipsoideae vel subgloboideae, pariete 1-2.5 µm crasso, aureo, echinulato, 5-6 poris papillis humilibus tectis dispersis instructis. Telia in pagina abaxiali foliorum, castanea, pulverulenta. Teliosporae 21-28 x 19-23 µm, ellipsoideae vel obovoideae, interdum apice complanatae vel angulares, pariete 1.5-2.5 µm crasso, ad apicem interdum usque 3.5 µm incrassato, cinnamomeo, ad apicem extus pallidior, laevi, pedicello hyalino, usque 60 µm longo, saepe brevius fracto.

Holotype: D.C. Rhodes 1437 (K), Zimbabwe, Matopo Hills, 21.04.1952 on Eragrostis rigidior Pilg. Isotype in NPPI.

Other specimens examined:

On Eragrostis rigidior Pilg.

Kenya. S of river Tana, 35 miles SE of Embu, 11.07.1953, A. Bogdan (3768), II + III.

Tanzania. Central Prov., Mpawapwa, 26.06.1948, II + III and 31.05.1951, II, both H.J. van Rensburg (445, 611).

Zimbabwe. Salisbury, 1500 m, 03.02.1971, R.M. Davies (3059), II + III.

On Eragrostis tef (Zucc.) Trotter (syn. E. abyssinica (Jacq.) Link)

Ethiopia. Wambar mariam, 2100 m, 28.10.1926, H. Scott & J.O. Cooper, II + III; Harrihoa 29.-30.10.1862, Schimper (975 d,e), III.

This species differs from U. eragrostidis Tracy especially in having teliospores not or only slightly thickened at apex and with hyaline pedicels.

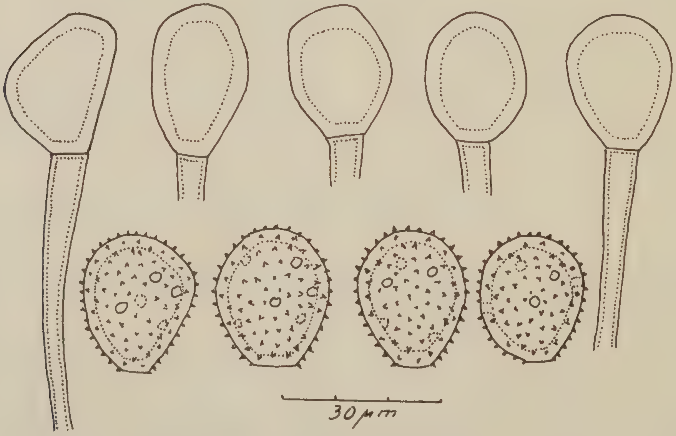

Fig. 13. Uromyces eragrostidicola sp.nov. Telio- and urediniospores from type.

UROMYCES ERAGROSTIDIS Tracy in J. Mycol. 7: 281 (1893).
On *Cypholepis yemenica* (Schweinf.) Chiov.
Botswana. Mpathalwa Pass, 13.03.1976, R.P. Ellis, II (det. R.W.G. Dennis).
On *Eragrostis ciliaris* (L.) R.Br.
Ghana. Legon Hill, 06.10.1955, C.D. Adams (3361, C), II.
On *Eragrostis kiwuensis* Jedw.
Uganda. Mt Moroto, 2700 m, 02.1959, J. Wilson (693), II + III; Kigezi, Kashenji, 28.11.1935, H.B. Johnston (1371), II.
On *Eragrostis superba* Peyr.
Uganda. Eastern Prov., Sukulu stock farm, 1935, H.E.L. Lloyd (11), II, (det. R.W.G. Dennis).
On *Eragrostis tef* (Zucc.) Trotter
Ethiopia. Eritrea, Asmara, 04.10.1964, J.R. Blair, II; Eritrea, Saganeiti, Degena valley, 2200 m, 26.03.1892, G. Schweinfurth & D. Riva (1261), II + III; Kaffa Prov., 23 km E of Bonga along road to Jimma, 1500 m, 14.01.1973, I. Friis et al. (2278, C), II.

U. eragrostidis is widespread in the Americas and in Africa, especially on *Eragrostis* spp., and it is also known from Israel, Pakistan, India, Turkmenia in USSR and in Australia. Its aecial stage which occurs on *Anthericum* (Liliaceae), is known from U.S.A.

UROMYCES HABROCHLOAE sp.nov. (Fig. 14)

Aecidia et uredinia ignota. Telia amphigena, exposita, pulvinata, fusca. Teliosporae 16-23 x 13-19 µm, obovoideae vel angulares, saepe apice truncatae, pariete laterali 1 µm crasso, ad apicem usque 8 µm incrassato, castaneo, laevi, pedicello hyalino, minus quam 20 µm longo.
Holotype: G. Jackson 2242 (K), Malawi, Karonga distr., Mweri Misuki, 06.1958 on *Habrochloa bullockii* C.E. Hubbard. Isotype in NPPI.

Hitherto no rust has been described on *Habrochloa*.

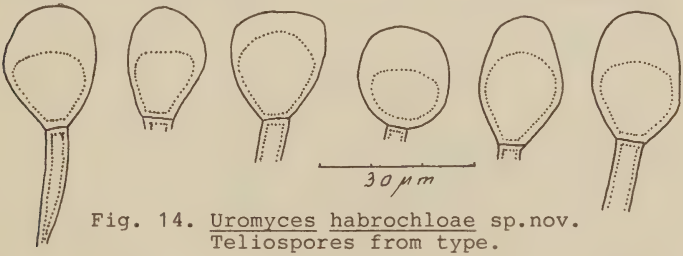

Fig. 14. *Uromyces habrochloae* sp.nov. Teliospores from type.

UROMYCES KENYENSIS Hennen in Hennen & Cumm., Mycologia 48: 158 (1956).
On *Chloris roxburghiana* Schult.
Zimbabwe. Shangani distr., Gurampa forest reserve, 06.1955, Herb. Salisbury (50398), (II +) III.

U. kenyensis has previously been known only from Kenya and Uganda. Another host species is *C. gayana* Kunth.

UROMYCES OBESUS Durrieu in Mycologia 79: 96, 1987.
On Heteropogon contortus (L.) Roem. & Schult.
Uganda. Mt. Elgon, Bulawasi, 1500 m, 13.12.1927, J.D. Snowden (1247), II + III.

This rust species is new to the African rust flora, described on the same host from Nepal. In the African specimen the urediniospores are somewhat larger, (27-)34-37 x (20-)33-37 µm, and with up to 14 pores, but as the teliospores match fairly well with the spores in the type specimen, I prefer to place it within this species.

UROMYCES PENTASCHISTIDIS sp.nov. (Fig. 15)

Aecidia et uredinia ignota. Telia amphigena, pro maxima parte in pagina abaxiali, exposita, pulvinata, fusca. Teliosporae (19-)22-24 x 19-22 µm, ellipsoideae, pariete lamelloso, laterali 3-4 µm crasso, ad apicem usque 8 µm incrassato, luteolo-brunneo, ad apicem extus pallidior, laevi, pedicello brunneolo, saepe collabente, usque 70 µm longo.
Holotype: R. Schlecther 1740 (K), S. Africa, Cape Prov., Riversdale 11.1892 on Pentaschistis airoides (Nees) Stapf. Isotype in NPPI.

To my knowledge no rust has previously been described on this host genus.

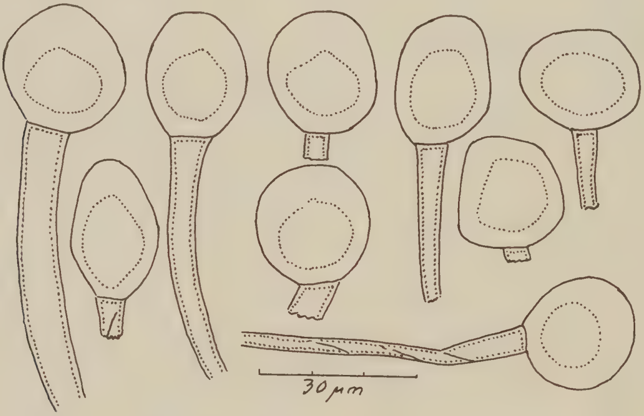

Fig. 15. Uromyces pentaschistidis sp.nov. Teliospores from type.

UROMYCES SETARIAE-ITALICAE Yosh. in Bot. Mag. Tokyo 20: 247 (1906).
On Brachiaria comata (A. Rich.) Stapf
Sudan. Torit distr., Equatoria, 620 m, 29.10.1949, J. Jackson (868), (II +) III.
On Melinis minutiflora P. Beauv.
Burundi. Bubanga Prov., near conflux of Kagunuzi and Karonge rivers, 1080 m, 28.11.1986, K.A. Lye (12204, NPPI), II.

In Africa this species, which occurs circumglobal, has been found on several host genera from the Mediterranean area southward to S. Africa. Both species mentioned above have been reported with this rust from Uganda, on the latter also from Malawi and Sierra Leone.

UROMYCES TENUICUTIS McAlp. in Rusts of Australia p. 87, 1906.
On *Sporobolus jacquemontii* Kunth
Kenya. Nairobi, 13.04.1947, A. Bogdan (503), II + III.
On *Sporobolus kentrophyllus* (K. Schum.) W.D. Clayton.
Somalia. Tugdheer reg., Tiyo plain, 18.06.1979, Hansen & Heernstig (6193), II + III.
On *Sporobolus natalensis* (Steud.) Th. Dur. & Schinz (syn. *S. capensis* (P. Beauv.) Kunth var. *laxus* Nees)
Ethiopia. Bahadur gorge, Lake Tana, 1920, G.W. Grabham, II.
Zaire. Kiwu Prov., Rubshuni, Bishusho, 1810 m, 28.08.1959, A. Leonard (5261), III; Kasai Prov., Mukamba road, 10.1956, Liben (1961), II.
On *Sporobolus pyramidalis* P. Beauv.
Ethiopia. Odde, 2600 m, 23.03.1958, H. Smeeds (1184 A), II + III.

This rust is widespread in warmer regions in Africa, Asia, Australia and the Americas, occurring on a large number of *Sporobolus* species. To my knowledge the rust has been recorded on *S. capensis* from S. Africa, Tristan da Cunha and New Zealand, but as the variety is not given it cannot be said whether *S. natalensis* is a new host for this rust.

UROMYCES TURCOMANICUM Katajev in Akad. Nauk Bot. Odt. Sporov. Rast. Bot. Mater. 8: 111, 1952.
On *Hordeum bulbosum* L.
Jordan. Gabel Amans (Moab), 600--700 m, 25.04.1945, P.G. Davies (8718), II + III.
On *Hordeum marinum* Huds ssp. *gussoneanum* (Farl.) (syn. *H. geniculatum* All.)
Libya. Cirenaica, Sirene-es Safsat, 18.04.1933, R. Pampanini (733); Cirenaica 650 m, 11.04.1939, N.Y. Sandwith (2245), both II + III.

Urom. turcomanicum has hitherto been known only from Iraq, Iran and Turcmenistan. *H. bulbosum* is the type host while *H. marinum* ssp. *gussoneanum* is new to this rust. Some teliospores on the latter host are somewhat longer than stated in the diagnosis, up to 28 µm.

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MYCOTAXON

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SOME FORGOTTEN DISCOMYCETE COMBINATIONS

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ABSTRACT

Thirteen combinations for discomycete names have been found in early volumes of the *Bulletin de la Société Mycologique de France* which have apparently been overlooked by all subsequent authors. Several common species names now require different author citations and/or different literature citations than ever have been adopted. A new name is proposed for the fungus illustrated by Boudier in his *Icones Mycologicae* as *Cyathipodia villosa: Helvella dissingii* Korf.

Perhaps because no complete indices to the volumes of the *Bulletin de la Société Mycologique de France* exist, thirteen apparent new combinations for discomycetes made in papers by L. Arnauld (**1893**), E. Boudier (**1897, 1898, 1899**), and N. Patouillard (**1906**) have not, to my knowledge, ever been noted by later authors. I call them to attention here, for amongst them are eight new combinations which I have cited incorrectly (Korf, **1986**) in my compendium on the names possibly applicable to the plates in Boudier's *Icones Mycologicae,* either as accepted names or as synonyms. These are indicated with an asterisk (*) below; since the compendium is arranged by the final plate number assigned by Boudier, the *Icones Mycologicae* plate number is also listed for ease of entry of these errata in volume 5 of the reprint edition. Names which I consider "generally acceptable modern" names are given in boldface.

In addition to the names I list here, there are many other apparent new combinations made in the *Bulletin* within articles or in lists of species collected on forays or brought to meetings. These are not validly published combinations when they lack author citation for the epithet and thus do not fulfill the requirements for a "reference (direct or indirect) to a previously and effectively published description or diagnosis ..." demanded by Art. 32.1*(c)* of the *International Code of Botanical Nomenclature.* Mere citation of the name(s) of or abbreviation(s) of the author(s) of an epithet is sufficient indirect reference for papers published prior to 1953 (Art. 33.2). No attempt was made to cover combinations in genera other than those of discomycetes, and post-1910 volumes of the *Bulletin* were not checked.

THIRTEEN REVISED AUTHOR AND/OR LITERATURE CITATIONS

ALEURIA BUXEA (Quél.) Arnauld (*'busxea'*), *Bull. Soc. Mycol. France* **9:** 111. 1893.

≡ ***Peziza buxea*** Quél., *C. R. Ass. franç. Av. Sci.* (Rouen, 1883) **12:** 509. 1884.

***ANTHRACOBIA MELALOMA** (Alb. & Schw. : Fr.) Arnauld, *Bull. Soc. Mycol. France* **9:** 112. 1893. [Icon. Mycol. pl. 387.]

≡ *Peziza melaloma* Alb. & Schw., *Consp. fung. lusat.* 336. 1805.

ASCOPHANUS HEPATICUS (Batsch) Boud., *Bull. Soc. Mycol. France* **13:** 15. 1897.

≡ *Peziza hepatica* Batsch, *Elench. fung. Continuatio* **1:** 199. 1786.

≡ ***Fimaria hepatica*** (Batsch) Brumm., *Persoonia* **2:** 322. 1962.

CILIARIA HIRTA (Schum. : Fr.) Arnauld, *Bull. Soc. Mycol. France* **9:** 112. 1893.

≡ *Peziza hirta* Schum., *Enum. pl.* **2:** 422. 1803.

≡ ***Scutellinia hirta*** (Schum. : Fr.) Kuntze, *Revis. gen. pl.* **2:** 869. 1891.

CILIARIA LIVIDA (Schum. : Fr.) Pat., *Bull. Soc. Mycol. France* **22:** 53. 1906.

≡ *Peziza livida* Schum., *Enum. Pl. Saell.* **2:** 422. 1803.

≡ *Trichophaea livida* (Schum. : Fr.) Boud., *Icon. mycol. Liste prélim.* p. [3]. 1904. [Doubtful species: *cfr.* Yang and Korf, **1985**, p. 523.]

***DISCIOTIS VENOSA** (Pers. : Fr.) Arnauld, *Bull. Soc. Mycol. France* **9:** 111. 1893. [Icon. Mycol. pl. 254.]

≡ *Peziza venosa* Pers., *Syn. meth. fung.* 618. 1801.

***DISCIOTIS VENOSA** (Pers. : Fr.) Arnauld var. **RETICULATA** (Grev.) Boud., *Bull. Soc. Mycol. France* **15:** 53. 1899. [Icon. Mycol. pl. 255.]

≡ *Peziza reticulata* Grev., *Scott. crypt. fl.* pl. 156. 1825.

*GALACTINIA BADIA (Pers. : Fr.) Arnauld, *Bull. Soc. Mycol. France* **9:** 111. 1893. [Icon. Mycol. pl. 283.]

≡ ***Peziza badia*** Pers. : Fr., *Observ. mycol.* **2:** 78. 1800.

*GALACTINIA CASTANEA (Quél.) Boud. (ut 'Q.'), *Bull. Soc. Mycol. France* **14:** 20. 1898. [Icon. Mycol. pl. 287.]

≡ *Peziza castanea* Quél., *Mém. Soc. Emul. Montbéliard,* sér. 2, **5:** 399. 1873.

= ***Peziza applanata*** (Hedw. : Fr.) Alb. & Schw., *Consp. fung. lusat.* 312. 1805.

GALACTINIA BOLTONII (Quél.) Boud. (ut '*Boltoni* Q.'), *Bull. Soc. Mycol. France* **14:** 20. 1898.

≡ ***Peziza boltonii*** Quél. (*'Boltonii'*), *Bull. Soc. Bot. France* **25:** 290. 1879 (1878).

*LEPTOPODIA VILLOSA (Schaeff.) Boud. *in* Arnauld, *Bull. Soc. Mycol. France* **9:** 111. 1893. [Icon. Mycol. pl. 240, as *Cyathipodia villosa.*]

≡ *Elvela villosa* Schaeff., *Fung. Bavar. Palat. nasc.* **4:** 114. 1774.

≠ *Helvella villosa* (Hedw.) Dissing & Nannf., *Svensk Bot. Tidskr.* **60:** 330. 1966 *(later homonym),* ≡ ***Helvella dissingii*** Korf.[1]

*OTIDEA GRANDIS (Pers.) Arnauld, *Bull. Soc. Mycol. France* **9:** 111. 1893. [Icon. Mycol. pl. 328.]

≡ *Peziza grandis* Pers., *Syn. meth. fung.* 639. 1801.

*TRICHOPHAEA WOOLHOPEIA (Cooke & Phill. *in* Cooke) Arnauld (*'Woolhopeïa'*), *Bull. Soc. Mycol. France* **9:** 112. 1893. [Icon. Mycol. pl. 365.]

≡ *Peziza woolhopeia* Cooke & Phill. *in* Cooke (*'Woolhopei'*), *Grevillea* **6:** 75. 1877.

ACKNOWLEDGEMENTS

Professor Donald H. Pfister, Farlow Herbarium, Harvard University, kindly acted as pre-submission reviewer of this note. Dr. Wen-ying Zhuang, formerly of this Department, also carefully checked the text.

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BOUDIER, E. **1898.** Descriptions et figures de quelques espèces de discomycètes operculés nouvelles ou peu connues. *Bull. Soc. Mycol. France* **14:** 16-23, pl. 3-5.

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DISSING, H. AND J. A. NANNFELDT. **1966.** *Helvella cupuliformis* sp. nov., *H. villosa* (Hedw. ex O. Kuntze) comb. nov., *H. macropus* (Pers. ex Fr.) Karst., and their allies. *Svensk Bot. Tidskr.* **60:** 325-337, pl. 1-3.

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[1]. Dissing (**1966a, 1966b**) and Dissing and Nannfeldt (**1966**) treat *Helvella (Elvela) villosa* Schaeff. as a questionable synonym of *Thelephora hirsuta* (Relh. : Fr.) Willd. and of *Auricularia reflexa* Bull. Though Boudier's plate is clearly the fungus they call *Helvella villosa* (Hedw.) Dissing & Nannf., that name cannot be applied to the species because it is a later homonym of Schaeffer's name. A new name for the Hedwig's species, which was not sanctioned by Fries, is required, and is provided here, using the same iconotype ('lectotype') designated by Dissing and Nannfeldt. A European neotype specimen, preferably a topotype, should be carefully chosen to replace the iconotype. The new name, which applies to the species illustrated by Boudier, is **Helvella dissingii** Korf, *nom. nov.* (basionym: *Octospora villosa* Hedw., *Descr. micr.-anal. musc. frond.* **2:** 54., pl. 19, f. B. 1789, non *H. villosa* Schaeff. 1774; typus Hedwig, *loc. cit.*, pl. 19, f. B.).

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AN UNDESCRIBED PATTERN OF ASCOCARP DEVELOPMENT IN SOME NON-CONIFEROUS LOPHODERMIUM SPECIES

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SUMMARY

Ascocarp development of *Lophodermium multimatricum* sp. nov., a species common on many angiosperms in New Zealand and South America, is described and illustrated. The pattern of development differs from that previously described for other *Lophodermium* species because the ascocarp primordium consists of vertically oriented rows of cylindrical cells, and a layer of vertically oriented cells remains present between the ascocarp walls and the hymenium at all stages of ascocarp development. Several other *Lophodermium* species from non-coniferous plants have the same pattern of development. It is suggested that the combination of developmental characters correlated with macroscopic features of the ascomata, could be used to segregate this group of species from *Lophodermium* s.l.

INTRODUCTION

There have been several studies on ascocarp development in conifer-inhabiting species of *Lophodermium* Chevallier and other closely related genera, including *Hypodermella* Tubeuf and *Lophodermella* Höhnel. Although there is disagreement regarding the nature of the sterile elements present amongst the asci, and the exact site of ascus development (see discussions in Uecker & Staley 1973, Campbell & Syrop 1975, Morgan-Jones & Hulton 1979) there is general agreement regarding the pattern of development of sterile tissues of the ascocarps (Jones 1935, Gordon 1966, Thyr & Shaw 1966, Uecker & Staley 1973, Campbell & Syrop 1975, Morgan-Jones & Hulton 1979). The ascocarp primordium consists of a mass of undifferentiated, interwoven hyphae (= "plectenchyma" as defined in Hawksworth et al. 1983) within which the hymenium develops (see, for example, illustrations in Campbell & Syrop 1975, figs 2, 3; Uecker & Staley 1973, figs 4, 5, 6). The part of the plectenchyma above the hymenium forms the upper ascomatal wall (often termed the clypeus) and that below the hymenium either forms a layer of undifferentiated, pseudoparenchymatous tissue or becomes darkened to form a differentiated lower wall. One exception to this general pattern has been reported by Gordon (1968) for *Lophodermium nitens* Darker. Morgan-Jones & Hulton (1977), however, disagreed with Gordon's interpretation of ascocarp development in this species.

The present paper describes a new species from New Zealand and South America, and reports the pattern of development seen in sterile tissues of the ascomata. Development in this species is compared with that previously described for other species of *Lophodermium*, and its taxonomic significance is discussed.

MATERIALS AND METHODS

Dried herbarium material was rehydrated in 3% KOH, and 8-10 µm thick sections of ascocarps and pycnidia were cut using a freezing microtome. Asci, ascospores, and paraphyses were examined from squash mounts made in 3% KOH and Melzer's solution. Cultural characteristics were determined from single ascospore isolates grown on 'Difco' oatmeal agar. Colonies were incubated at 20°C under near ultraviolet and cool white fluorescent light, with a cycle of 12 hour light/12 hour dark.

RESULTS

Lophodermium multimatricum sp. nov. (Figs 1, 2, 7)

Ascocarpi elliptici, atri; margine induti duobus cum stratis quorum, stratum intorsum cellulas habet verticales; paraphyses ramosae; asci 95-130(-150) x 6-8 µm, cylindrici, apices versus decrescentes; ascosporae 75-100 x 1.5-2 µm, in muco involutae.

HOLOTYPE: New Zealand, Buller, vic. Murchison, Maruia Saddle, Warbeck Scenic Res., on *Rubus cissoides*, coll. Johnston (R161) et al., 16 Apr 1983 (PDD 46125).

ETYMOLOGY: *multi-* = many, *-matricum* = matrix, host; refers to large number of plant species on which this fungus is found.

Ascocarps forming on fallen leaves, in discrete groups within pale yellowish areas, or in some collections in undifferentiated areas. Not associated with zone lines or with anamorph pycnidia.

In surface view immature, unopened ascocarps appear macroscopically as two blackened areas separated by a broad, pale longitudinal zone. In some collections the paler zone is less defined, and immature ascocarps appear as a single blackened area more or less elliptical in outline, with a narrow paler zone extending longitudinally along the ascocarp. Mature, opened ascocarps 0.3-0.8 (-

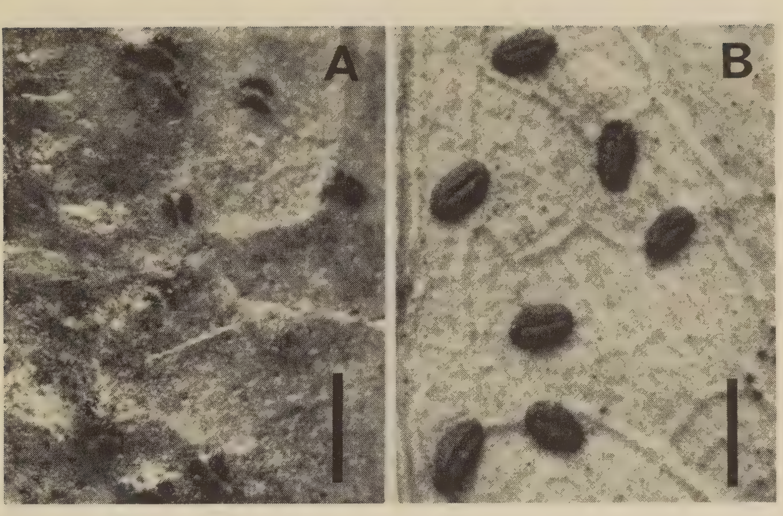

Fig 1 *Lophodermium multimatricum* . Macroscopic appearance of ascocarps. A. Immature ascocarps. B. Mature ascocarps. (bar scale = 1mm).

2.0) x 0.2-0.3 mm, walls black, the ascocarp raising the host surface so that the wall becomes steeply angled to the surrounding leaf surface. Ascocarps developing a distinctive, black, flattened area adjacent to both sides of the elongate, slit-like opening. Lip cells absent.

Ascocarps subepidermal to intraepidermal. In vertical section in immature ascocarps there are three distinct layers of tissue surrounding the developing hymenium, termed here an upper wall layer, a lower wall layer, and an inner layer. The separate upper and lower wall layers both comprising dark brown, thick-walled cells. The upper wall 10-15 µm wide, the lower wall up to about 5 µm. Between the upper and lower walls is the third, inner layer, comprising hyaline, thin-walled, cylindrical cells arranged in vertical rows. The hymenium develops within the inner layer following a breakdown of some of the vertically arranged cells near the centre of the ascocarp. In mature ascocarps the upper wall is up to 20 µm wide. There is a narrow extension to the upper wall bordering the ascocarp opening, and this covers the top of the hymenium. It consists of very dark tissue, and is oriented at right angles to the rest of the upper wall.

Paraphyses 1-2 µm diam., unswollen, branching 2-3 times near apex, extending 20-30 µm beyond asci. Asci

95-130(-150) x 6-8 µm, cylindric, tapering to rounded apex, wall not thickened at apex, 8-spored. Ascospores 75-100 x 1.5-2 µm, tapering slightly to both ends, 0-1 septate, surrounded by a narrow gelatinous sheath.

CHARACTERISTICS IN CULTURE: Ascospores from seven collections germinated on agar within 2-4 days. The appearance in culture was variable. In most isolates on oatmeal agar, colonies were 50-70 mm diam. after 3 weeks, aerial mycelium was cottony, white to pale grey, agar surface was not discoloured. Black-walled, more or less globose bodies developed near centre of colonies, mostly remaining sterile but in one collection (PDD 43259) containing immature asci.

In isolates from two collections (PDD 43038 and PDD 43036) aerial mycelium was sparse, white, stringy, agar surface was brown to vinaceous-brown, with globose, black-walled pycnidia with yellowish conidial ooze present on agar surface. Pycnidia were up to 250 µm diam., walls up to 30 µm wide, pseudoparenchymatous, outermost 2-3 layers of cells with dark brown, thickened walls, otherwise of thin-walled, hyaline cells. Conidiogenous

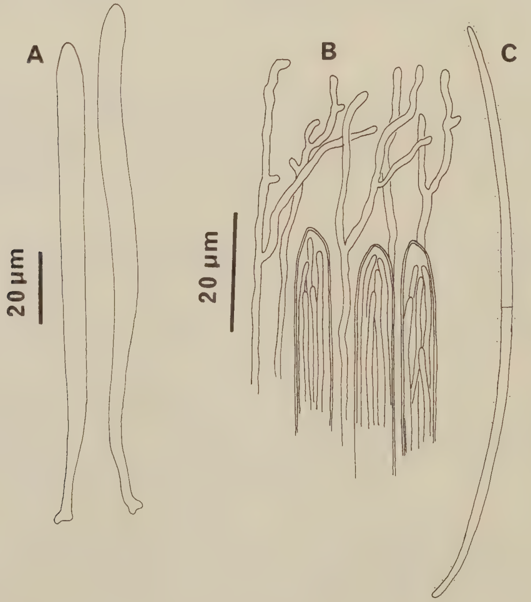

Fig 2 *Lophodermium multimatricum* (PDD 46125). A. Asci. B. Apex of asci and paraphyses. C. Released ascospore.

layer lined whole of the single, convoluted locule. Conidiogenous cells 10-22 x 2.5-4 µm, discrete, more or less flask-shaped, sympodial, often with two conidia held at apex. Conidia 3-7 x 0.8-1.2 µm, cylindric with rounded ends, nonseptate, hyaline.

HABITAT: Fallen leaves of *Beilschmiedia tawa, Cordyline* spp., *Clusia* sp., *Dendrobium* sp., *Dracophyllum pyrimidale, Elaeocarpus hookerianus, Freycinetia baueriana* ssp. *banksii, Gahnia* sp., *Gaultheria* spp., *Hoheria* sp., *Knightia excelsa, Leptospermum* sp., *Metrosideros fulgens, Nestegis lanceolata, Nothofagus dombeyi, N. fusca, N. menziesii, N. truncata, Phormium* sp., *Pseudopanax* spp., *Rhopalostylis sapida, Ripogonum scandens, Rubus cissoides, Weinmannia racemosa.*

DISTRIBUTION: All parts of New Zealand, also from Chile, Venezuela.

SPECIMENS EXAMINED: Over 60 collections have been examined including: New Zealand, BULLER, E. of Murchison, between 6-Mile and Matakitaki, on *Pseudopanax* sp., coll. Johnston (R190) et al., 16 Apr 1983 (PDD 43972). NELSON, Lake Rotoiti, on *Pseudopanax* sp., coll. Johnston (R43), 13 May 1982 (PDD 43246). WAIKATO, vic. Waitomo, on *Beilschmiedia tawa*, coll. Kendrick (KNZ167), 14 Jan 1974 (PDD 40553). TAUPO, Kaimanawa State Forest Park, Cascade Hut Tr., on *Nothofagus menziesii*, coll. Johnston (R428) & McKenzie, 26 Mar 1984 (PDD 46125).
South America, CHILE, Valdivia, on *Nothofagus dombeyi*, coll. Butin, 22 Sep 1968 (ZT - as *L. hysterioides*). VENEZUELA, border Dpto. Federal and Edo. Miranda, La Silla, on *Clusia* sp., coll. Dumont (VE-106) et al., 18 Jun 1971 (NY - filed under *Propolis emarginata*, which is also present on this collection).

NOTES: Two features distinguish *L. multimatricum* from other *Lophodermium* species found in New Zealand:

1. a layer of cylindrical cells arranged in vertical rows between the wall layers and the hymenium; and
2. ascomata which lack lip cells but which at maturity have a black, flattened area adjacent to both sides of the ascocarp opening. In vertical section this flattened area is seen as a distinct, narrow extension to the upper wall, stretching across the top of the hymenium.

Several other *Lophodermium* species, described from other parts of the world on various angiosperm hosts, also have these two distinctive features (see below). *L. multimatricum* is distinguished from these species by the shape of the paraphysis apex, by the width and shape of the ascus apex, and by the presence or absence of anamorph pycnidia.

Pattern of ascocarp development in *Lophodermium multimatricum*

Both mature and immature ascomata are found at all times of the year, and all stages of ascocarp development may be present in individual collections. The less mature ascocarps are near the edge of the usually discrete groups of ascocarps.

Ascocarps are first visible macroscopically as small round to elliptic, greyish areas. In vertical section they consist of a series of vertically oriented rows of hyaline, thin-walled, cylindrical cells embedded beneath the host epidermis. The bottom cell of each row is pale brown and its outermost wall is slightly thickened (Fig 3).

A horizontal split develops across some of these rows of vertically arranged cells (arrowed in Fig 3). A layer of "true" paraphyses (i.e. growing upwards from the base of the locule and never attached at their apices) arise from disorganised, hyphal cells which develop near the base of the cavity formed by this split. The remains of the broken rows of vertically oriented cells can be seen above and below the developing paraphyses, and unbroken rows of these cells are present to both sides of the space into which the paraphyses are growing (Fig 4). With further development the ascocarp becomes wider and deeper as the unbroken rows of vertically oriented cells grow longer. At this stage the lowermost cells of the vertical rows become darker brown and thicker walled and start to differentiate into a distinct lower ascocarp wall. A few dark brown, thick walled fungal cells are now present within the previously empty epidermal cells of the host (Fig 4), and as the paraphyses continue to lengthen these cells almost fill the epidermal cells, so forming a differentiated upper wall layer. Two or three of the epidermal cells near the centre of the ascocarp remain empty (Fig 5). At this stage, in surface view, the ascocarps appear macroscopically as two separate blackened areas. The paraphyses now become closely septate in their lower half, and hyphal bridges develop between adjacent paraphyses (Fig 5).

The ascocarp starts to open with the breakdown of epidermal cells which do not contain the dark brown fungal cells of the upper ascocarp wall. Simultaneously the

Figs 3-7 *Lophodermium multimatricum* (PDD 46125). Vertical median transverse sections of ascocarps at different stages of development. All at same scale. See text pp. 388-390 for details.

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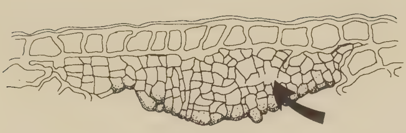

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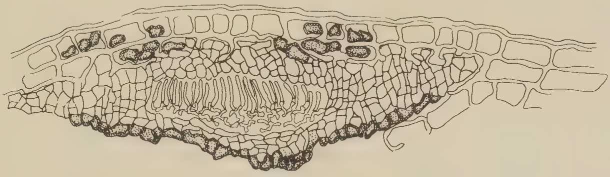

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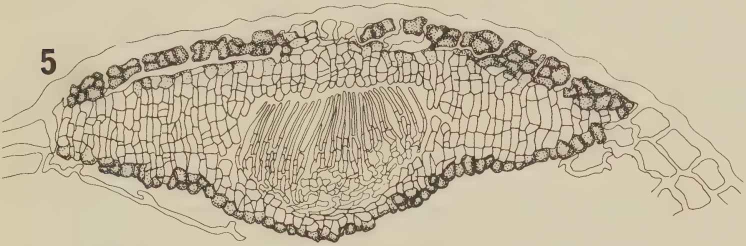

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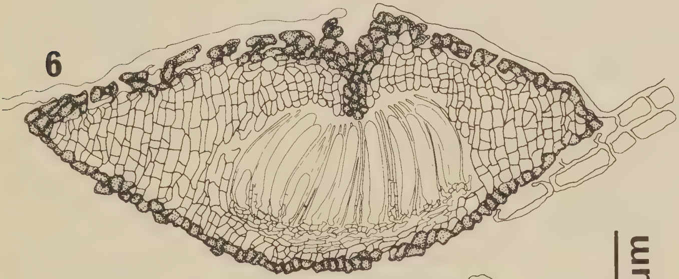

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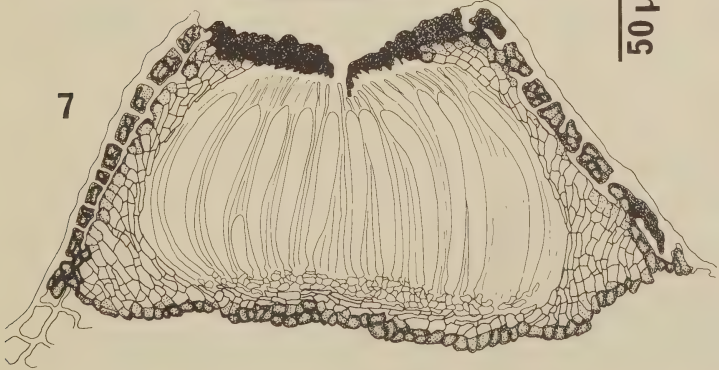

upper wall becomes more extensive near the centre of the ascocarp, developing a narrow group of dark brown cells which extend at right angles to the rest of the wall, down through the remains of the vertical rows of hyaline cells which are still present above the hymenium (Fig 6). Asci start to develop at this stage. The exact site of ascus development was not observed.

As ascospores develop, the hymenium expands and the top of the ascocarp is raised above the level of the surrounding leaf tissue. The upper ascocarp wall becomes almost vertical in orientation, with the top of the hymenium covered by the narrow extension to the upper wall which first develops as the ascocarp starts to break open (Fig 7). By this time the extension is very dark without a distinct cellular structure. The hyaline, vertically oriented cells which surrounded the developing hymenium are still present, although, except at the outer edge of the base of the ascocarp, they are crushed and misshapen because of the pressure exerted by the developing hymenium.

When wet the hymenium further expands and the sides of the ascocarp are forced apart so that the top of the hymenium is exposed. When dry the hymenium is completely enclosed, covered by the narrow extensions to the upper wall which developed adjacent to the ascocarp opening. It is the development of these extensions to the upper wall which give the ascocarps their characteristic macroscopic appearance.

Other *Lophodermium* species with the same pattern of ascocarp development as described for *L. multimatricum*.

This list has been compiled following examination of the specimens and/or illustrations cited. It is probable that other *Lophodermium* species also belong in this group.

L. aleuritis Rehm (Philippines, Los Baños, on dead leaves, coll. S. A. Reyes, 27 May 1914 - S; C. F. Baker Fungi Malayana #154 - S).
L. breve (Berkeley) de Notaris (Campbell Is., on *Uncinia hookeri* - Holotype, K).
L. camelliicola Minter (India, Assam, on *Camellia sinesii*, coll. Tunstall, 9 Aug 1922 - Holotype, IMI 23122). Illustration, Cannon & Minter 1986, page 59.
L. dracaenae Phillips & Harkness (USA, California, May 1881, Harkness collection of fungi #2514 - Holotype, BPI).
L. "hawaiense" Petrak (Hawaii, Pogues Ditch Trail, on *Polypodium* sp., coll. Shear, 30 Dec 1927 - Type, W).
L. hederae Dennis & Spooner (Azores, Sao Miguel, Ponta Delgada, on *Hedera* sp., 21 Mar 1975 - Holotype, K).
L. hedericola Ahmad (Pakistan, Ghora Gali, on *Hedera nepalensis*, coll. Ahmad, 14 Apr 1962 - Holotype, IMI 292063). Illustration, Cannon & Minter 1986, page 71.

L. javanicum Penzig & Saccardo (Java, Tjibodas, on *Elettaria* sp., coll. O. Penzig, 1897 - ? Type, W).
L. mangiferae Koorders. Type material not examined but several collections identified as this species in IMI (IMI 297389 on *Hydnocarpus*, Malaysia; IMI 207753 on *Mangifera*, India; IMI 956459 on *Mangifera*, Guinea; IMI 285291 on *Spatholobus*, India) fit into this group. Not all IMI collections labelled as *L. mangiferae* belong in this group. Illustration, Cannon & Minter 1986, page 73.
L. passiflorae Rehm (Philippines, Los Baños, on *Passiflora quadrangularis*, coll. C. F. Baker #406, Dec 1912 - ? Holotype, S; Philippines, Los Baños, on *P. quadrangularis*, coll. C. F. Baker, 5 Sep 1913 - S).
L. planchoniae Rehm (Philippines, Los Baños, on *Planchonia spectabilis*, coll. C. F. Baker #3080, 4 Apr 1914 - S; C. F. Baker Fungi Malayana #156 - S, W).
L. reyesianum Rehm (Philippines, Los Baños, on fallen leaves, coll. S. A. Reyes, 15 Aug 1913 - S).
L. rotundatum Sydow (Philippines, Prov. Laguna, near Los Baños, Mt. Maquiling, on *Dillenia* sp., coll. C. F. Baker, Dec 1913, Fungi Malayana #39 - Type, W; also present on same leaves as *L. reyesianum* in collection cited above - S).
L. smilacinum Petrak (USA, Hawaii, Olinda Pipe Line, on *Smilax* sp., Shear & Stevens, 29 Dec 1928 - Holotype, W).
Lophodermium sp. (Chile, Valdivia, on *Gevuina avellana*, coll. Butin, 22 Sept 1968 - ZT, as *L. hysterioides*).
Lophodermium sp. (USA, California, Humboldt Co., coll Parks (4650), 6 Feb 1931 - IMI 23082, as *L. exaridium*).
Lophodermium sp. (USA, Hawaii, Oahu, on *Metrosideros* sp., coll. Loring (2853), 11 May 1947 - BPI).
Lophodermium sp. on various hosts from South America, (numerous collections examined including, Venezuela, Edo. Aragua, Parq. Nac. Henry Pettier, Maracay-Choroni Rd., on *Clusia* sp., coll. Dumont (CO-5961) et al, 12 Jun 1971 - NY. Nova Granata, 186m, Herb. Lindig 2891, Herb. J.J.Triana (1829-1890), on *Clusia* sp. - K, as *L. hysterioides*. There are two other *Lophodermium* species also present on this collection).
Clithris pandani Tehon. Illustration, Tehon 1918, plate IX, fig 6.

DISCUSSION

The ascocarp primordium of *L.multimatricum* is similar to that described by Gordon (1968) for *L. nitens*, with both consisting of a series of vertically oriented rows of cylindrical cells. However, the pattern of development described by Gordon (1968) differs from that of *L. multimatricum* in two respects. In *L. nitens* at an early stage of development the vertically arranged cells became dark brown, and the vertical arrangement was lost before the ascocarps matured. Morgan-Jones & Hulton (1977) examined other collections of *L. nitens*, disagreed with Gordon's interpretation, and found the pattern of development to be the same as that previously described for other *Lophodermium* species. They claimed the vertically arranged cells illustrated by Gordon (1968) were an artifact caused by sectioning close to the edges of the ascocarps. Assuming that the collections examined in these two studies represent the same species, then Gordon's observations must be considered suspect, although Gordon included collections with subepidermal as well as subcuticular ascocarps in his concept of *L. nitens*. Darker (1932) in the original description of this species, and Minter (1981), both described *L. nitens* as having subcuticular ascocarps, and regarded this feature as diagnostically useful. It is possible that Gordon's material represented another *Lophodermium* species. Whatever the case, the ascocarp primordium consisting of vertical rows of cylindrical cells described in this study for *L. multimatricum* is not an artifact caused by the position at which the vertical sections were cut, the same structure is seen in serial sections down the entire length of an ascoma. It remains uncertain if any *Lophodermium* species on Pinaceae have this kind of ascocarp development.

Most non-coniferous *Lophodermium* species examined, including *L. arundinaceum* (Schrader)Chevallier, the type species of *Lophodermium*, have an ascocarp primordium comprising plectenchymous tissue as previously described for *Lophodermium* by Morgan-Jones & Hulton (1977, 1979) and others (unpublished observations). However, the species listed above in the results section form a distinctive and easily recognisable second group, with a primordium comprising rows of vertically oriented, cylindrical cells. *Lophodermium* as at present circumscribed includes any member of the Rhytismataceae with filiform ascospores, and an ascocarp opening by a single longitudinal slit. The group of species sharing these two characters is large and heterogeneous. The heterogeneous nature of *Lophodermium* has long been recognised (e.g. Darker 1932, Tehon 1935). However the only attempt to reorganise *Lophodermium* (Tehon 1935) was rejected by later authors (e.g. Terrier 1942, Darker 1967, Cannon & Minter 1986) in spite of these authors acknowledging the unsatisfactory nature of the genus.

The Rhytismataceae vary considerably in the way the sterile ascocarp tissues develop, in the way the ascocarp opening develops, and in the development and nature of the structures which line the openings of mature ascocarps (unpublished observations). These characters may be useful in redefining generic limits within the Rhytismataceae. The developmental characters shared by *L. multimatricum* and the other *Lophodermium* species listed, could usefully and conveniently be used to segregate out these taxa from *Lophodermium* into a new, clearly definable genus. The feature of having a layer of tissue comprising vertically oriented cells between the ascocarp wall and the developing hymenium is seen at all stages of ascocarp maturity. The macroscopic characteristic of a black, flattened area adjacent to the ascocarp opening means that this group can also be distinguished in the field.

Many of the species in this group also have a second distinctive, macroscopic character. In surface view the immature ascocarps appear as two parallel dark patches separated by a paler zone (Fig 1A). This feature was noted by Cannon & Minter (1986) for *L. mangiferae*, and is seen in most collections of *L. multimatricum*, however, its presence is variable, and in some species is not seen at all. Some other species, which do not have the mode of ascocarp development characteristic of this group, for example *Lophodermium agathidis* Minter & Hettige, may also have a well developed paler zone down the centre of immature ascomata. Thus, this feature, although distinctive, must be used with caution.

The segregation of the present group from *Lophodermium* s.l., although not formally proposed here, would be a start to the long overdue rearrangement of this heterogeneous genus. Before doing this there is a need for a monographic revision of all species which possess the developmental characters discussed here.

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PLASMOPARA LACTUCAE-RADICIS, A NEW SPECIES ON ROOTS OF HYDROPONICALLY GROWN LETTUCE [1]

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SUMMARY

Plasmopara lactucae-radicis is described as a new species of downy mildew from roots of hydroponically grown *Lactuca sativa* L. in Virginia. It differs from *P. helianthi* Novotelnova f. *helianthi*, the only other downy mildew known to sporulate on roots, in having shorter sporangiophores that lack a swollen base, non-verticillate ultimate branches, and unipapillate sporangia. *Plasmopara lactucae-radicis* has been found only on roots.

In August, 1987, lettuce plants (*Lactuca sativa* L. cv. Ostinata and Salina) exhibiting root-rot symptoms were obtained from a commercial greenhouse in Rapidan, Virginia. Microscopic examination revealed the presence of a downy mildew-like fungus on the roots. Profuse aerial development of sporangia occurred on the roots, but not on leaves, following incubation in humidity chambers. Oospores were also observed in decayed root tissues. An "on site" visit of the greenhouse in September, 1987 by the senior author revealed that the fungus was sporulating on roots of lettuce plants of all ages and was uniformly distributed throughout the 2.4 ha facility which employs the nutrient film technique of cultivation. Repeated attempts to isolate the fungus on agar medium were not successful. Since the morphological characteristics of this fungus, in addition to its occurrence on roots of cultivated lettuce, could not be matched or found in a survey of the literature, it is here described as a new species. Details on the ecology and pathology of the fungus will be published elsewhere.

PLASMOPARA LACTUCAE-RADICIS Stanghellini and Gilbertson, sp. nov.

Sporangiophoris in radices, hyalinis, singulis vel fasciculatis, a vesiculus exorientibus, 5-10 µm late, 150-520 µm altitudinae; 3-5 pinnatis; ramos ultimis fusoideus, rectis ad flexis, 10-40 µm longis; sporangia ovata vel ellipsoidea, unipapillatae, crassitunicatae, 40-91 x 29-52 µm, germinationis a zoosporis; zoosporis 40-160 per sporangium, circa 10-12 µm in diam; sporangiophoris secundarius saepe exorientibus ramos ultimis; oosporis apleroticus, crassitunicatae, laeves, 28-32 µm in diam. Hab. in radices *Lactucae sativae*, Rapidan, Virginia; Holotypus: AZ 16100, in herb. National Fungus Collections, Beltsville, Maryland.

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[1] Univ. of Ariz. Agricultural Exp. Station Journal Paper 4442.

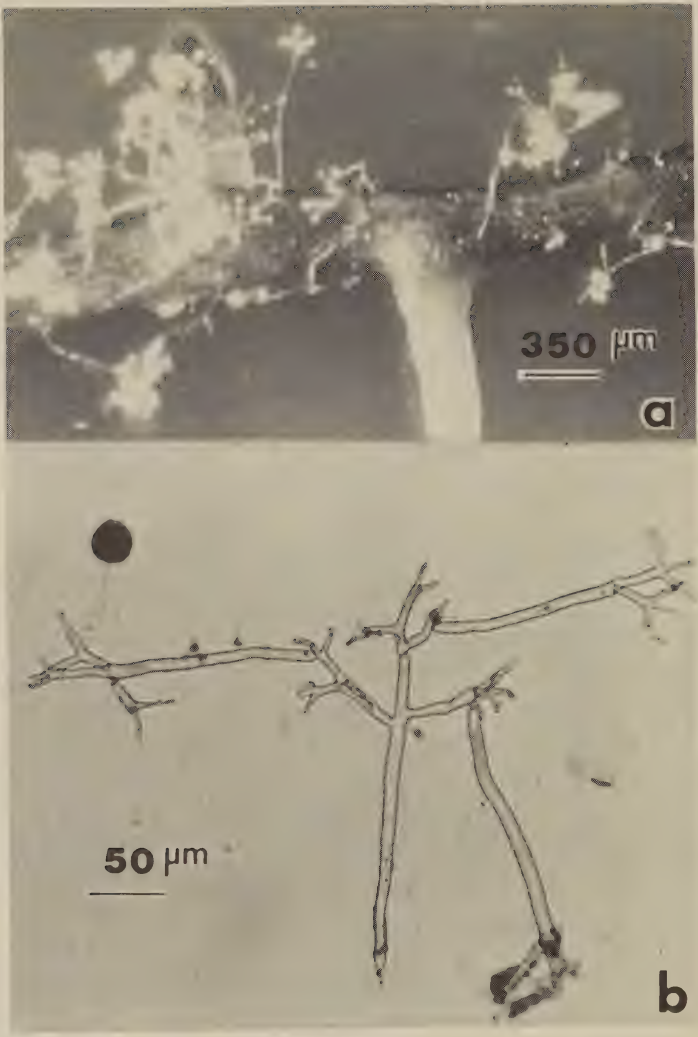

Fig. 1. *Plasmopara lactucae-radicis*. a, sporangiophores and sporangia on root; b, sporangiophore showing development of secondary sporangiophores from sterigmata.

Sporangiophores hyaline, developing on roots, singly or in clusters, arising from swollen vesicles in host tissue; main axis of sporangiophore 5-10 µm in diam, 150-520 µm in height, monopodially branched with 3-5 primary branches; primary branches 5-10 µm in diam,

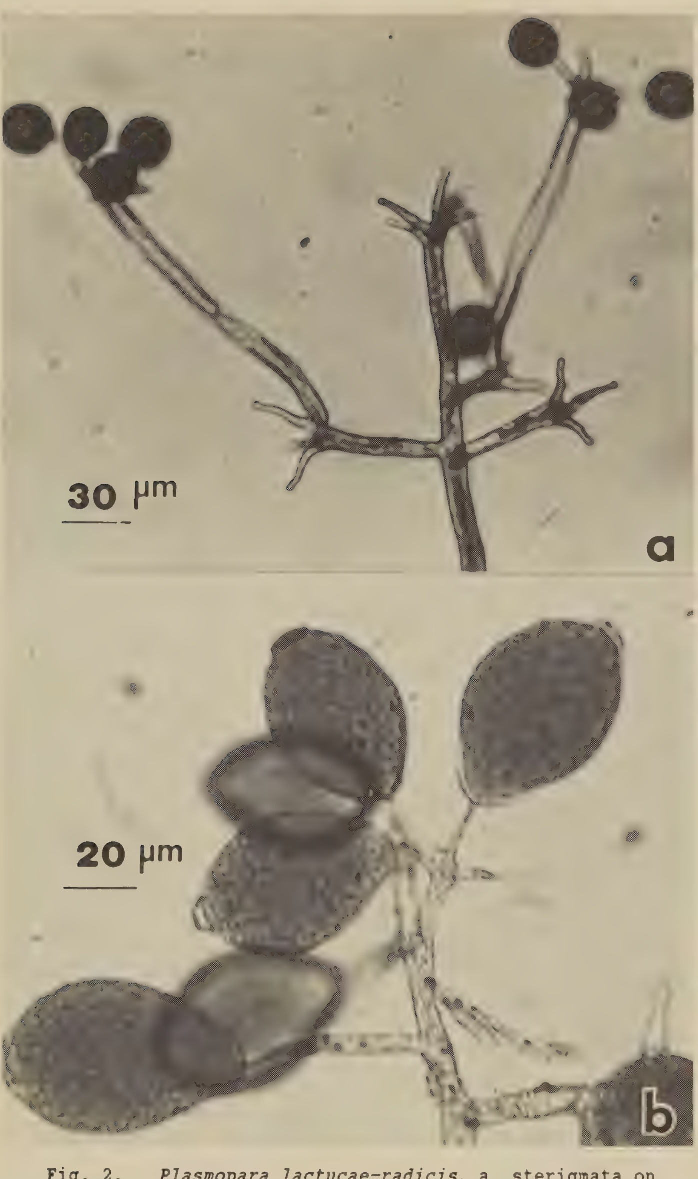

Fig. 2. *Plasmopara lactucae-radicis.* a, sterigmata on primary sporangiophore and development of secondary sporangiophores from sterigmata; b, sporangia showing single apical papilla.

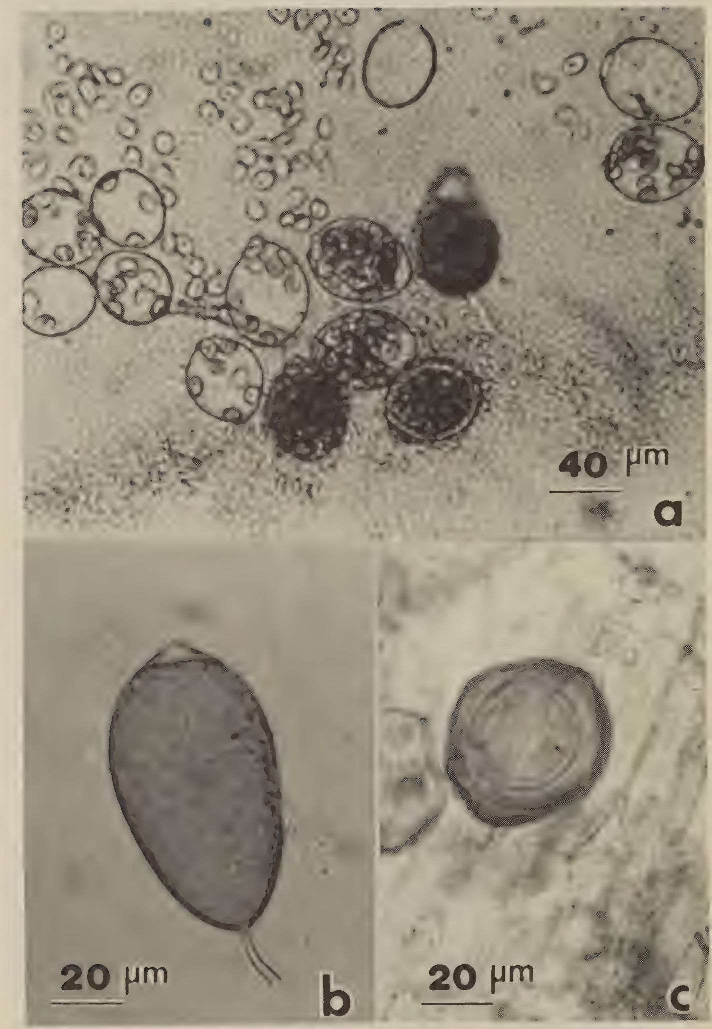

Fig. 3. *Plasmopara lactucae-radicis.* a, sporangia liberating zoospores; b, sporangium showing apical papilla and basal septum; c, oogonium and oospore in root tissue.

arising at acute to right angles, secondary branches 3-5, not verticillate, arising at acute to right angles, producing sporangia or sporangium producing tertiary branches, ultimate sporangium producing

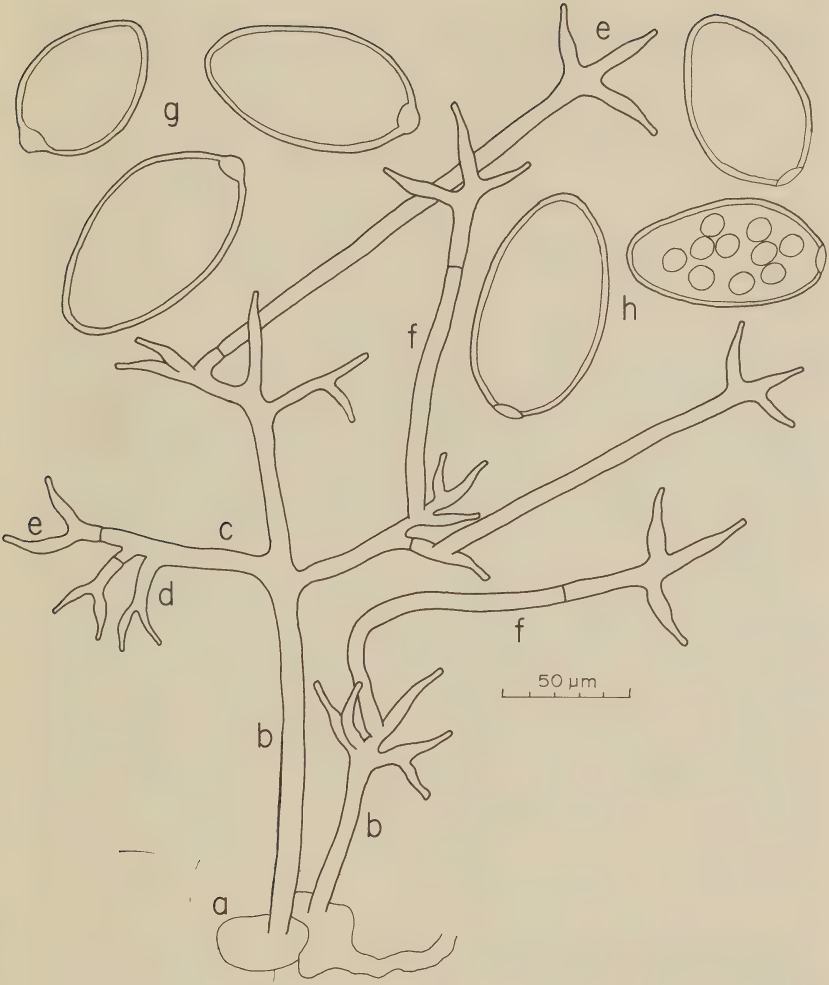

Fig. 4. *Plasmopara lactucae-radicis.* a, vesicular hyphal structures imbedded in root tissue; b, primary sporangiophores arising from vesicles; c, primary branches; d, secondary branches; e, ultimate branches (sterigmata); f, secondary sporangiophores arising from sterigmata; g, sporangia showing apical papillae; h, sporangia after zoospore discharge showing apical pore.

branches or sterigmata tapered to the tip, occasionally septate near the base, 4-6 µm in diam at the base, 1-3 µm in diam at the tip, 10-40 µm long, straight or curved, truncate at the tip, some giving rise to long, straight, stout secondary sporangiophores 100-220 µm long and 6-9 µm in diam that produce branches and sporangia as do the primary sporangiophores; sporangia cut off by a septum below the base of the sporangium, hyaline, ovate to ellipsoid, with a single apical papilla, 40-91 x 29-52 µm (mean 70 x 45 µm), wall up to 2 µm thick, germinating by dissolution of the apical papilla and release of zoospores; zoospores approximately 40-160 per sporangium, about 10-12 µm in length, leaving the sporangium singly or in a compact mass and separating after exiting; encysting to form spherical microcysts about 10 µm in diam; oogonia developing in cortical tissue of host roots, irregularly ellipsoid, 45-50 µm in diam; oospores aplerotic, 28-32 µm in diam, spherical, smooth-walled at maturity, wall 2.5-3 µm thick, germination not observed; sporangia on roots placed on water agar occasionally observed to germinate directly by germ tube, those in water observed to germinate by zoospores only.

The only downy mildew previously known to produce sporangiophores on roots of its host is *Plasmopara helianthi* f. *helianthi* (Nishimura 1926; Novotelnova 1966; Spencer 1981). According to Novotelnova (1966) and Zimmer (1974) this fungus is restricted to annual sunflower (*Helianthus annuus* L.). *Plasmopara halstedii*, a species with a wide host range in the Compositae, has been reported on wild lettuce (*Lactuca canadensis* L.) in Maryland (Anonymous 1960). However, no specimens of *P. halstedii* on wild lettuce could be found, and this record could not be confirmed. Additionally, no reports of any downy mildews sporulating on roots of lettuce were found in the literature.

Plasmopara lactucae-radicis is morphologically similar to *P. helianthi* f. *helianthi* on annual sunflower roots in size of sporangia and in proliferation of terminal branches to produce secondary sporangiophores. However, *P. lactucae-radicis* is clearly distinguished from *P. helianthi* f. *helianthi* by the absence of a swollen base on its sporangiophores, its non-verticillate branching habit, and its strictly unipapillate sporangia. In addition to these morphological distinctions, *P. lactucae-radicis* sporulates only on roots of cultivated lettuce whereas *P. helianthi* f. *helianthi* sporulates on leaves as well as on roots of annual sunflower.

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TAXONOMICAL STUDIES ON USTILAGINALES. I.

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ABSTRACT

The name Ustilago turcomanica Tranzschel (on Eremopyrum spp.) is validated. The following new combinations are proposed: Sporisorium consanguineum (Ell. & Ev.) Vánky, based on Sorosporium consanguineum (on Aristida spp.), and Sporisorium bursum (Berk.) Vánky, based on Ustilago bursa (on Anthistiria arundinacea). The following names are considered synonyms: Doassansia borealis Liro, and D. alpina Lavrov (both on Sagittaria natans) are synonyms of D. sagittariae (Fuck.) C. Fisch. Entyloma schweinfurthii P. Henn. (on Polypogon monspeliensis) is E. dactylidis (Pass.) Cif. Thecaphora orobi Ziling (type on Orobus luteus) is identical with Thecaphora deformans Dur. & Mont. ex L.-R. & C. Tul. Tilletia transiliensis Kuzn. & Schwarz. and T. sabaudae Zogg (both on Poa nemoralis) are synonyms of T. paradoxa Jacz. Ustilago grossheimii Ul'yan. (neotype on Zerna gussonei) is U. bullata Berk. Ustilago jaczevskyana Lavrov var. sibirica Lavrov (syntype on Hierochloa odorata) is U. striiformis (Westend.) Niessl. Ustilago michnoana Lavrov (syntype on Elymus dasystachys) is U. serpens (Karst.) B. Lindeb. Ustilago sinkiangensis Wang (type on Polygonum sp.) is a synonym of U. piperii G.P. Clint. Ustilago kazachstanica Gutner & Sergeeva (type on Aneurolepidium angustum) is U. trebouxii H. & P. Sydow. Lygeum spartum is parasitised at least by two species of Ustilago: on the stems by the plurivorous U. hypodytes (Schlecht.) Fries, and in the inflorescence by U. sparti Massenot. The name Ustilago lygei (nom. nud.) refers to U. hypodytes. Entyloma echinopsis Schwarzman (on Echinops sphaerocephalus) is excluded from the Ustilaginales since it is a bacteriosis. Lectotypes are selected for Doassansia alpina and Ustilago jaczevskyana var. sibirica, and neotype for Ustilago grossheimii.

In the course of my studies of smut fungi (Ustilaginales) from Europe and elsewhere, I have seen a great number of types and other specimens. Many interesting facts came to light. Several taxonomical and nomenclatorial problems appeared. I have found inexactnesses, nomina nuda and contradictions in the literature. I have also confirmed earlier assumptions. Some specimens showed to be undescribed species. The study of some types revealed that they are in fact not smut fungi. Others turned out to be nomenclatorial or taxonomic synonyms. I have selected some of these problems to present in a series of papers.

To elucidate the taxonomical position of the three known Doassansia species on Sagittaria spp. in Europe and Siberia, I studied the types of D. sagittariae (Fuckel) C. Fisch (including the type of Protomyces bizzozerianus Saccardo, 1876, in Sacc. Mycoth. Veneta 889), D. borealis Liro, and D. alpina Lavrov. I compared the spore ball structure and the measurements of the spores and sterile cells. These studies revealed no essential differences, except for a rather great variability in the form and size of the cortical sterile cells. The characteristics of the cortical cells served for the description of D. borealis. In some of the spore balls of D. borealis and D. alpina, the sterile cells are smaller and longer than those in D. sagittariae. These may vary not only from one specimen to another, but also from spore ball to spore ball within the same sorus and, moreover, within the same spore ball, measuring between 15–25 µm in length. Other spore balls of these species do not differ in any way. In spite of the rather large variability in the form and size of the sterile cells, I consider these species conspecific as follows: Doassansia sagittariae (Fuckel) C. Fisch – Physoderma sagittariae Fuckel, 1865. Type on Sagittaria sagittifolia L., Germany "bei Hattenheim im Altrhein", automn, L. Fuckel, in Fuckel, Fgi. rhenani exs. 1549, 1865 (HUV 514!). – Doassansia borealis Liro, 1934. Type on Sagittaria natans Pallas, Finland, Savonia bor., Kuopio, 10.VIII.1933, M.J. Kotilainen, in Mycoth. fenn. 210, 1934 (HUV 474!). – Doassansia alpina Lavrov, 1937:4. Type on Sagittaria natans, USSR, Siberia, (sel. here) Yakutskaya ASSR, Verhoyanskij reg., lake Myuryu between Yakutsk and Aldan river, 20.VIII.1925, K. Benua (LEP!).

Entyloma schweinfurthii P. Hennings, 1902:(210), has been described from Egypt on Polypogon monspeliensis (L.) Desf. (Gramineae). Several authors mistakenly reported it from Polygonum monspeliense Guss. (Polygonaceae). The description of this fungus agrees with the plurivorous, graminicolous Entyloma dactylidis (Passerini) Ciferri, with characteristic small, lead-coloured sori and dark, smooth spores. Consequently, I consider E. schweinfurthii a synonym of E. dactylidis. I have not seen its type, but I have seen two specimens on Polypogon monspeliensis, under the name of "Tolyposporella semenoviana" Lavrov (including the type), which are also typical E. dactylidis (Vánky, 1985:61).

Sorosporium consanguineum Ellis & Everhart, in ovaries of different species of Aristida (Gramineae), forms at first persistent, later decomposing spore balls. I propose to transfer it into the genus Sporisorium as Sporisorium consanguineum (Ellis & Everhart) Vánky, comb. nov. Basionym: Sorosporium consanguineum Ellis & Everhart, Journal of Mycology 3:56, 1887. Type on Aristida rusbyi Scribner (= A. arizonica Vasey), USA, N. Arizona, coll. Rusby. Germination of the spores originating recently from Australia, resulted in long, septate promycelia giving rise laterally and terminally to basidiospores (A. Nagler, pers. comm.).

The study of the type of Thecaphora orobi Ziling, in Murashkinskij & Ziling, 1927:25, on Orobus luteus L. (= Lathyrus gmelini Fritsch), Asia, N. Altai, Chamir valley, near Kozlushka, 16.VIII.1926, M.K. Ziling (LEP!) confirmed my earlier conclusion (Vánky 1985:124), based only on the description of this species, that it is a synonym of Thecaphora deformans Durieu & Montagne ex L.-R. & C. Tulasne.

There is a group of Tilletia species which has unusual large spores and a very characteristic ornamentation. These species are: T. paradoxa Jaczewski, Tilletia transiliensis Kuznetzova & Schwarzman, and T. sabaudiae Zogg. The spores are globose or subglobose and measure 37–52 x 37–58 µm. In LM the surface of the spores are obscurely reticulate with 6–10 meshes per spore diameter and finely verruculose muri; in median view a 4–6 µm wide corona surrounds the spores with erect ridges or ridges curved in one direction (optical phenomenon?). In SEM the surface of the spores appear densely and narrowly tuberculate. Sterile cells between the spores are smaller (10–30 µm long), hyaline, with a 3–7 µm thick, smooth wall. A study of the types of these species did not reveal any essential differences. Their taxonomical position is considered as follows: T. paradoxa

Jaczewski, 1926:169, type on Phleum sp., USSR, Transcaucasia, between Ipchreuli and Dioban, 19.VIII.1910, H. Popov (AA!, originating from Tiflis). – Syn. Tilletia transiliensis Kuznetzova & Schwarzman, in Schwarzman, 1960:240, type on Poa nemoralis L., USSR, Kazakhstan, reg. Alma-Ata, Mt. Zilinskij Alatau, in valley Kazachki, 8.X.1957, S.R. Schwarzman (AA!), – T. sabaudiae Zogg, 1983:91, type on Poa nemoralis L., Frace, "in Alpibus Sabaudiae" (= prov. Savoie), 1851, J. Müller-Argoviensis (NEU!).

A specimen in Alma Ata (AA!), labelled as T. poae Nagornyj, collected by Nagornyj in or near the type locality of this species but one year later, contains typical T. paradoxa. T. poae is, however, a quite different species, having inter alia spores of 30–35 µm in diameter. An additional specimen, seen by me, collected on Poa nemoralis in France, reg. Alpes-Maritimes, near the village St. Martin-Vésubie, Mt. Argentera, "Madone de Fenestre", 2200 m, 25.VII.1965 (GZU!) belongs also to T. paradoxa.

The type of Ustilago bursa Berkeley, in scattered ovaries of Anthistiria arundinacea shows the characters of the genus Sporisorium. Sori in ovaries, surrounded by a peridium, the spores are formed in many-spored balls (40–100 µm long) which are easily decomposed in spores (7–10 x 8–11 µm). I propose to transfer it into this genus as Sporisorium bursum (Berkeley) Vánky, comb. nov. Basionym: Ustilago bursa Berkeley, in Hooker's J. Bot. Kew Gard. Misc. 6:206, 1854. Type on Anthistiria arundinacea Roxb. (= Themeda gigantea (Cav.) Hock var. arundinacea (Retz.) Hock), India, Sikkim (Herb. Berk. 4733, 1879; K!). – Syn. Sphacelotheca bursa (Berk.) Mundkur & Thirumalachar, 1946:6.

Ustilago grossheimii Ul'yanishchev, 1950:74, was described on Zerna gussonei Parl. (= Bromus rigidus L. subsp. gussonei (Parl.) Cout., = Bromus diandrus Roth) from USSR, Azerbajdzhan, peninsula Apsheron, near the village Pirshagi, not far from Baku, collected on 27.V.1938 by V.I. Ul'yanishchev. The holotype was lost by fire in the herbarium of Baku (BAK) c. 20 years ago (Prof. Ul'yanishchev, pers. comm.). However, I got a sample from Prof. Ul'yanishchev, collected on the same host, in the same locality some years earlier (on 21.VI.1936) which I propose for neotype. The study of the neotype, and of additional specimens collected by me in and around Baku recently, could not reveal any essential differences between this species and Ustilago bullata Berkeley. Consequently, U. grossheimii is considered a synonym of U. bullata.

The syntype of Ustilago michnoana Lavrov, 1936:17, on Elymus dasystachys Trin., USSR, Yakutskaya ASSR, lower reach of the Amga river, near the village Uryunchaj, 26.VII.1925, I. Benua (LEP!) is Ustilago serpens (Karsten) B. Lindeberg, similarly to the lectotype (Vánky 1985:234).

The type of Ustilago sinkiangensis Wang, 1962:134, with sori as anastomosing pustules on the leaves of a Polygonum sp., China, Sinkiang, Ta-cheng, Ha-mu-sze-tai, 26.VIII.1959, Liu Hen-ying (731; in "HMAS" 31560, Beijing, copy in HUV 7992!) is indistinguishable from Ustilago piperii G.P. Clinton, 1904:382, presenting 6–11 µm long, pale brownish-violet spores with the typical spore surface ornamentation resembling fingerprint markings. Consequently, U. sinkiangensis is considered a synonym of U. piperii, alike to Sphacelotheca polygoni-alpini P. Cruchet, 1908:247 (Vánky 1985:228).

Ustilago turcomanica was named and distributed by W. Tranzschel, apparently without any description. This smut is somewhat similar to U. bullata but differs from it by larger spores and by the characteristics of the spore germination.

Ustilago turcomanica Tranzschel ex Vánky sp. nov. – *Ustilago turcomanica* Tranzschel, in Tranzschel & Serebrianikow, Mycotheca rossica 302, 1912 (nomen nudum). – Typus in matrice *Triticum squarrosum* Roth. (= *Eremopyrum bounapartis* (Spreng.) Nevsky), USSR, Turkmenya, Austro-Occid. versus ad Komsomol'sk (Chardzhou), pr. pag. Repetek, 4.V.1911, leg. Androssow, in Tranzschel & Sereb., Mycoth. ross. 302 (Holotypus in herbario HUV 4892!, isotypi in Tranzschel & Sereb., Mycoth. ross. 302).

Sori tumefacti, in ovariis ad basim palearum et glumarum formati, cooperti per membranam tenuem, in statu lacerato multitudinem sporarum atrobrunneam, semi-pulverulentam exponentem. Sporae globosae, subglobosae, ellipsoideae usque parum irregulares, episporio 1–1,5 µm crasso, fere leves usque plerumque dense et leniter verrucosae, 9–11 x 9,5–14(–15) µm, mediocriter olivaceo-brunneae, in polis parum pallidiores. Germinatio: promycelium 2- vel 3-septatum, plerumque a basi 2–4-ramosum, e quo in aqua mycelium, in mediis nutrientibus basidiosporae laterales et terminales.

Sori as in *Ustilago bullata* Berkeley. The spores measure 9–11 x 9.5–14(–15) µm. Germination (Brefeld 1895:114; Fischer & Meiners 1952:209) by a 2–3-septate, usually from the base 2–4-branched promycelium, in water giving rise to mycelium, in nutrient media developing lateral and terminal basidiospores. In nature, *U. turcomanica* seems to be confined to *Eremopyrum* species, but it may artificially infect even *Elymus* s. lat. species (Fischer & Meiners 1952:208). It is known from E. Europe, Asia and North America (USA, probably introduced from Asia).

A study of the types of *Ustilago trebouxii* and *U. kazachstanica* revealed that they are conspecific. Consequently the correct name of this fungus should be *Ustilago trebouxii* H. & P. Sydow, 1912:214, type on *Triticum cristatum* (L.) Schreber (= *Agropyron cristatum* (L.) Gaertner, USSR, Novotscherkassk, 17.IV.1911, O. Treboux (LE!). – Syn. *Ustilago kazachstanica* Gutner & Sergeeva, 1941:75 (n.v.), type on *Aneurolepidium angustum* (Trin.) Nevski (= *Leymus karelinii* (Turcz.) Tzvelev, USSR, Kazakhstan, Dzhezkazgan raion, 15 km from Dzhezkazgan to Karabulak, 26.VII.1936, K.S. Sergeeva (AA!, LE!, HUV 12136!); on *Elymus giganteus* Vahl (= *Leymus racemosus* (Lam.) Tzvelov), USSR, Kazakhstan, Akmolinskij rajon, between the lakes Bozgum and Karakul, 18.VI.1913, V.F. Semenov (LEP!).

I found one of the syntypes of *Ustilago jaczevskyana* Lavrov var. *sibirica* Lavrov in Leningrad–Pushkin (LEP), namely that on *Hierochloe odorata* (L.) Beauv, from USSR, Far East, distr. Vladivostok, near the river Lyanchin, 29.VII.1927, I.N. Abramov (lectotype, sel. here). This variety belongs to *Ustilago striiformis* (Westendorp) Niessl, as does the main variety (Vánky 1985:238) on the same host plant. The differences in the spore measurements lie within the range of the normal variability of this species.

On *Lygeum spartum* L. (Gramineae) were reported four *Ustilago* species: 1) *U. hypodytes* (Schlecht.) Fries, 2) *U. spegazzini* Hirschh. var. *agrestis* (H. Sydow) Fischer & Holton, 3) *U. lygei* Rbh., and 4) *U. sparti* Massenot. Inter alia Angus (1956:118) and Vánky (1985:214-217) showed, that *U. spegazzini* and its var. *agrestis* are synonyms of *U. hypodytes*. "*Ustilago lygey* Rabenh." was distributed in the exsiccata "Un. itin. crypt. 1866. Dr Marcucci" under No. IV, without any description. Apparently Rabenhorst never compiled a description for this name. Moreover, in his exsiccata Fungi europaei No. 1800, in 1874, he distributed a similar smut fungus on this host plant under the name *Ustilago hypodytes* var. *lygei*. (One notices, that in Rabenhorst's usage the variety means a connection to a special host plant rather than a morphological deviation from the species). A study of "Rabenhorst's species" in Un. itin. crypt. 1866, No. IV (HUV 9301!), showed that it is typical U. hypodytes. This species develops its sori on the stems and rarely also on the floral axis of the more or less aborted inflorescence of different grasses belonging to a great number of genera. The spores measure 4–6(–7) µm in lenght. The sori of U. sparti are restricted only to the floral parts of Lygeum spartum, the spores are larger measuring 6.5–8 µm in lenght, usually with a lighter area. Consequently, the four species of Ustilago reported on Lygeum spartum belong to two species: the common U. hypodytes, and the more rare collected U. sparti.

EXCLUDED SPECIES

A study of the type of Entyloma echinopsis Schwarzman, 1960:288 (on Echinops sphaerocephalus L., USSR, Kazakhstan, Western Tyan'-Shan', at the Koksu river, 19.VII.1949, S.R. Schwarzman; AA!) did not reveal any spores of Entyloma type but rather abundant masses of bacteria (= bacteriosis) and spherical cells of host plant origin.

ACKNOWLEDGEMENTS

I express my gratitude to Professor F. Oberwinkler (Tübingen, Germany), for creating excellent working conditions for me at his Institute. I am most grateful to Dr L. Holm (Uppsala, Sweden) for reading of the manuscript, to Dr S. Tóth (Gödöllő, Hungary) for the Latin diagnosis, to Dr A. Nagler (Tübingen, Germany) for the discussions and reading of the manuscript, and to Miss S. Süssbrich for technical assistance with microscopical preparations of Doassansia spp. I am very much obliged to the Directors and Curators of the herbaria AA, BAK, GZU, "HMAS" (Beijing), K, LE, LEP for lending types and other specimens, and for exchange of smut fungi.

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TWO NEW POLYPORES FROM BURUNDI IN AFRICA

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SUMMARY

Oligoporus africanus Ryv. and **Perenniporia dendrohyphidia** Ryv. are described as new. The former is characterized by small, allantoid and amyloid spores, the latter by cystidioles, dendrohyphidia and skeletal hyphae, which are dextrinoid and become olivaceous green in KOH.

Dr. J. Rammeloo has in the recent years collected extensively in Central Africa and has over years sent me many polypores for identification. In a collection from Burundi there were two polypores which seem to be undescribed, both typified by rather remarkable characters. I would like here to express my thanks to Dr. J. Rammeloo for his generosity in sending specimens.

Oligoporus africanus Ryv. nov. sp.
Fructificatio sessilia; pileus glaber, ochraceus ad pallide brunneus, Pori facies labus ubi vivus, pallide brunneus ubi siccus, contextus albus, pori angulatis, 4-5 per mm,systema hypharum monomiticum, hyphae generatoriae fibulatae, sporae allantoidae, hyalinae, leviter amyloideae, 3.5-4.5 x 1-1.2 µm. Holotype Burundi, Muramyya, Teza, 20 Dec. 1978. Leg.J. Rammeloo 6155. (Herb. B, isotype in Herb. O).

Basidiocarp pileate, annual, spathulate to dimidiate, 5 x 3 cm, up to 8 mm thick at the base, fragile when dry, probably soft when fresh, upper surface glabrous, wrinkled and folded radially when dry, probably smooth when fresh; white at the margin, becoming darker towards the base, sordid pale brown and black with a distinct cartilaginous and very dense crust at the base; pore surface pale ochraceous to pale grey, pores angular, thin-walled, 4-5 per mm, more irregular of outline when dry, but entire and partly shrunken, tubes concolorous with pore surface, fragile, partly translucent and difficult to tear apart in microscopical preparations, up to 2 mm deep, context white and loose contrasting with the tubes, 2-6 mm thick.
Hyphal system monomitic, generative hyphae with clamps, hyaline, moderately branched, agglutinated in the trama, 2-4 µm wide, more irregular in the context with large clamps,

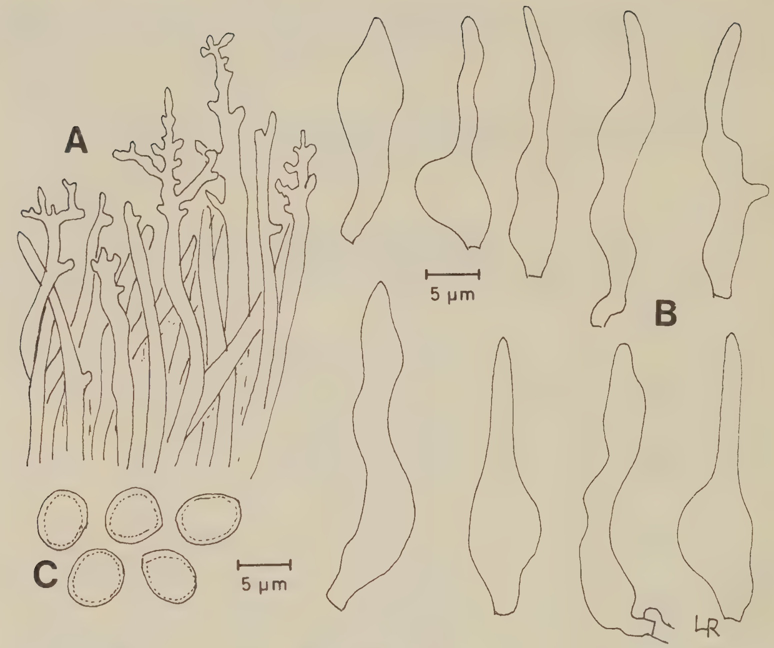

Fig. 1. **Perenniporia dendrohyphidia** a) Dendrohyphidia from the dissepiments, b) Cystidoles from the hymenium, c) Spores. From the holotype.

moderately branched, but also with some stout side-branches, 4-8 µm wide. Basidia clavate, 4-sterigmate, 8-10 x 4-5 µm, cystidia not seen, spores allantoid, smooth, hyaline and amyloid, 3.5-4.5 x 1-1.2 µm. From the substrate apparently associated with a brown rot of an angiosperm. This new species is related to the group of species around **O. caesius** (Fr.) Gilb. & Ryv., sharing the same type of basidiocarp, hyphal system and allantoid, slightly amyloid spores. However, **O. africanus** has much smaller spores than either **O. caesius** (Fr.) Gilb. & Ryv., **O. subcaesius** (David) Ryv. or **O. luteocaesius** (David) Ryv.For a description of the three latter species, see David (1980).

Perenniporia dendrohyphidia Ryv. nov. sp.
Fructificatio resupinata, pori ochracei, 6-7 per mm, contextus pallide griseus, systema hypharum dimiticum, hyphae generatoriae fibulatae, 2-3 µm in diametro, hyphae skeletales crassitunicatae, 2-5 µm in diametro, dextrinoideae, pallide olivaceus in KOH, cystidioles hyalinae, papillatae, 20-25 x 3-7 µm, dendrohyphidia ad marginem poris adsunt, sporae globosae, crassitunicatae, dextrinoideae, 5-6 µm in diametro.
Holotype: Burundi: T. Rutana, Mosso, Bekemba, 12. Jan.

1979. J. Rammeloo no. 6286, herb. B, isotype in herb. O. Basidiocarp resupinate, adnate, tough and hard, widely effused, up to 15 x 5 cm in the paratype and to 5 mm thick, pore surface wood-coloured to pale isabelline, margin absent to very narrow, pores round, 6-7 per mm, tubes concolorous, up to 5 mm deep, context cottony and fibrous, grey becoming darker towards the substrate, 1-2 mm thick. Hyphal system dimitic. Generative hyphae with clamps, hyaline, moderately branched, 2-4 µm wide, skeletal hyphae dominant, thick-walled, flexuous, moderately branched, towards the apex with a tendency to arboriform branching, dextrinoid, distinctly olivaceous in 3% KOH, especially in older parts of basidiocarp, the colour reaction is very distinct in hyphal masses, cystidioles present, hyaline, ventricose to clavate, with elongated neck, a few with a protuberance, 20-25 x 3-7 µm wide, arising from a clamp, basidia not seen with sterigmata, but bulbous organs, 6-12 µm in diameter may represent immature basidia, dendrohyphidia abundant along the pore-ridges, branched in the apex, hyaline and up to 55 µm long, arising from a clamp, spores globcse, slightly thick-walled, dextrinoid and 5-6 µm in diameter.

This is a very remarkable species in **Perenniporia** to which it belongs owing to the dextrinoid skeletal hyphae and thick-walled, dextrinoid spores. The deviating and unique characters are the olivaceous reaction of the skeletal hyphae in KOH, the presence of dendrohyphidia in the pore mouths and the strange mammillate to bottle-shaped cystidioles. None of the three latter characters has so far been reported for the genus. The dendrohyphidia are not easy to observe as they collapse easily, apparently during the drying, and several sections have to be made to obtain a proper observation. An olivaceous reaction in the skeletal hyphae seems to be completely unknown in the Polyporaceae, but it is known from several species in **Collybia**. (Halling 1979, 1981)

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NOTES ON LACHNELLULA THEIODEA

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Peziza theiodea Cke. & Ell. was published based on an Ellis collection from New Jersey (Cooke & Ellis, 1878) and was later transferred to the genus *Lachnellula* by Saccardo (1889). Since then, the taxonomic situation of this interesting fungus has been discussed twice (Korf, 1962; Dennis, 1963), but the generic name has not been changed, even though both authors expressed doubt on the assignment of this species to *Lachnellula.*

Almost all known specimens collected in North America were examined carefully by Korf (1962), and the morphology of this species was described and illustrated in detail. He stated that "the ectal excipular layer of this discomycete is unlike that known to me in any other of the 'hairy inoperculate discomycetes,' and I suspect that the fungus may represent an as yet undescribed genus. ... The question of its placement in the classification on a natural basis remains doubtful." He indicated also that "For the time being, the fungus can be left to slumber in the genus *Lachnellula,* as natural classification of the Discomycetes progresses, it will surely need another generic name." (Korf, 1962). It is clear that Saccardo's transfer of the fungus to *Lachnellula* was based on the presence of granulate hairs and spherical ascospores. Little can be found in common in the anatomical structure of this discomycete and that of other *Lachnellula* species. The highly gelatinized, elongated, very thick-walled, interwoven excipular hyphae are not *Lachnellula*-like, and the shape of hairs is wrong for *Lachnellula*. This fungus is found associated with other fungi on decorticated wood of angiosperms while species of *Lachnellula* are typically found on the bark of conifers.

When Dennis studied the type specimen of this species, he noted "these are not the hairs of a typical *Lachnellula*. It may possibly be a *Pithyella*, but I have not studied the type species, *P. hypnorum* (Quél.) Boud., and prefer not to propose a transfer here" (Dennis, 1963). [He meant to write "*P. hypnina* (Quél.) Boud."] The type of the genus *Pithyella* has marked ascospores, smooth hyphal protrusions if any, and is moss-inhabiting (Korf & Zhuang, 1987). *Lachnellula theiodea* is neither a species of *Pithyella* nor of *Lachnellula.*

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neither a species of *Pithyella* nor of *Lachnellula*.

The specific epithet *theiodea* means sulphur-like and is a summary of part of the original description: "the sulphury powder which covers the cups is sprinkled over the matrix" (Cooke & Ellis, 1878). All the authors who studied this fungus were interested in the yellow powder covering the cups. I have seen it in some of the collections. They are crystals which dissolve in aqueous KOH and very possibly are secreted by the fungus.

When a photograph of the holotype of *Hyphodiscus gregarius* Kirschst., type species of the genus *Hyphodiscus* Kirschst. (1907), was found by me attached to a 1984 letter from Dr. Wolf-Rüdiger Arendholz to Prof. Korf came to my attention, the excipular structure and short, apically granulate hairs of this species attracted my interest. The photograph shows many characters of *Lachnellula theiodea*. The holotype of *H. gregarius* was therefore borrowed. My type examinations proved that *L. theiodea* and *H. gregarius* are synonyms. *Hyphodiscus* is the correct generic name for *L. theiodea*. The correct specific epithet for the fungus should be *theiodea,* and a transfer to *Hyphodiscus* is required.

Examination of type specimens also revealed that *Mollisiella austriaca* Höhnel is another later synonym of *Lachnellula theiodea* (Cke. & Ell.) Sacc. *Mollisiella austriaca* was erected by Höhnel (1903) based on a tiny discomycete which grew on an old thallus of *Peniophora cinerea* on decaying wood of *Fagus* sp. Only one collection was found under *M. austriaca* in the Höhnel Herbarium of FH and the species appears to have been ignored by mycologists other than Saccardo (1906), who accepted the name and copied Höhnel's original description in the Sylloge Fungorum. Three of the five known North American collections of *L. theiodea* are also on the fruit bodies of *Peniophora* sp., but the host fungus is too inconspicuous to have been noticed by any of the collectors. Korf (1962) illustrated a brown *Calycellina*-like basal ring of the apothecium of this fungus. My observation reveals that the brown cells do not belong to the discomycete, but to the host fungus instead. I checked each plant substrate of these collections very carefully and came to the conclusion that *L. theiodea* is a fungicolous or fungus-associated fungus, and its apothecia are often found on fruit bodies of *Peniophora* sp. or other fungi on the same substrate. This discomycete occurs mainly in the early spring, but it has been collected once in September.

One thing which needs to be clarified is the type of *Mollisiella austriaca*. The type specimen was sent from the Höhnel Herbarium at FH. The label on the packet is full of information. The measurements of microscopic characters on the label match those in the original description well. The generic name was first put down as *Pulparia*, followed by the specific epithet *austriaca*. Then *Pulparia* was crossed out, and *Mollisiella* was substituted at the top. In his discussion, Höhnel (1903) stated that "Die beschriebene Art steht der *Pulparia australis* Speg. (Sacc. Syll. X, p. 38) aus Brasilien nahe, ist aber von ihr gut zu unterscheiden." Later, *Mollisiella* was also crossed out and *Niesslella* was written down at margin of the label, but the combination in *Niesslella* was never published by Höhnel. No questions can be raised on the locality and substrates when

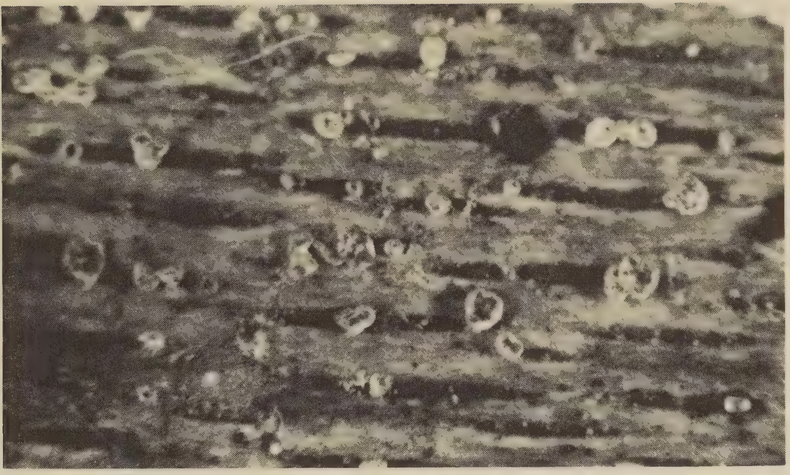

FIG. 1. Apothecia of *Hyphodiscus theiodeus* on substrate, from R.P.K. 3277, x 17.5.

comparing the information given on the label with that in the original description. The only problem is the collection date, which appears on the label as "27. 2. 1903" but was published as "March, 1902." Prof. Korf has suggested to me that this is merely a inversion of month and year. Prof. Pfister of FH indicates that this is the only specimen in FH under any of these names. I checked Höhnel's paper and found that the latest collection included in that paper was dated June, 1903. The collecting date, 27. 2. 1903, is not too late for publication in the paper. My conclusion is that this specimen is the type of *M. austriaca.*

Generic and specific descriptions are provided as follows:

Hyphodiscus Kirschst., Verh. Bot. Vereins Prov. Brandenburg 48: 44, 1907 (1906).

Apothecia solitary to gregarious, turbinate, discoid, or applanate, sessile; hymenium yellowish brown, receptacle concolorous, surface downy. Hairs short, nonseptate to 1-septate, with rod-like granules mostly on the apical cell, subhyaline to pigmented, more or less thick-walled. Ectal excipulum of textura intricata, with hyphae gelatinized, thick- and glassy-walled. Medullary excipulum of textura intricata, less gelatinized. Asci inoperculate, 8-spored, J+ in Melzer's reagent with or without aqueous KOH pretreatment. Ascospores unicellular, hyaline, smooth-walled, guttulate. Paraphyses filiform, septate.

On woody substrates, often associated with other fungi.

Type: *Hyphodiscus gregarius* Kirschst.

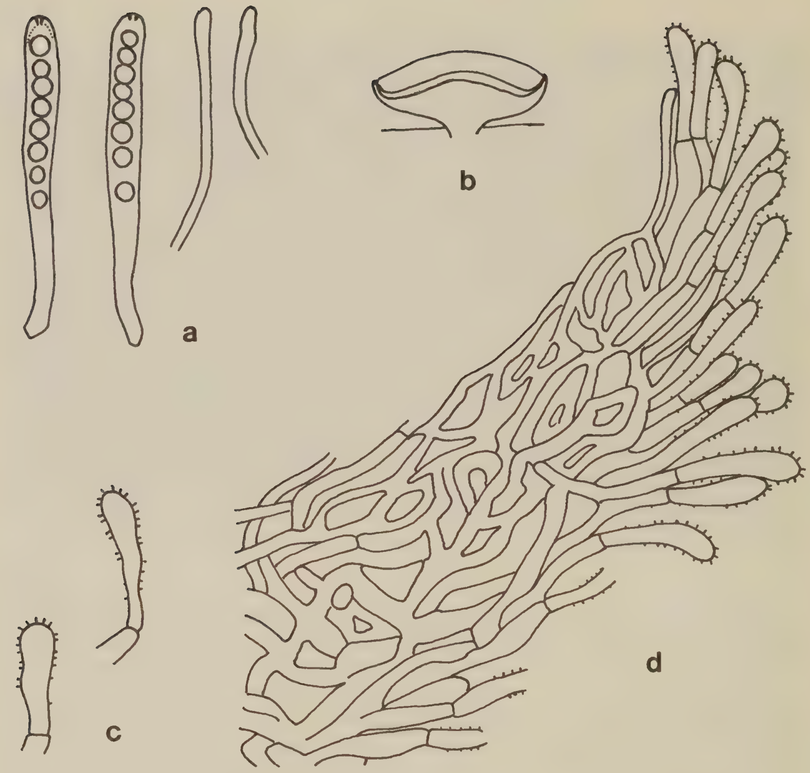

FIG. 2. *Hyphodiscus theiodeus:* **a**. paraphysis apices and asci with ascospores (R.P.K. 3277), **b**. shape of apothecium, from top to bottom showing hymenium, medullary excipulum and ectal excipulum (R.P.K. 2943), **c**. granulate hairs (R.P.K. 3277), **d**. structure of excipulum (R.P.K. 2943); **a** x 50, **b-d** x 1000.

Hyphodiscus theiodeus (Cooke & Ellis) Zhuang, **comb. nov.** (Figs. 1, 2)

≡ *Peziza theiodea* Cke. & Ell., Grevillea 7: 7, 1878.

≡ *Lachnellula theiodea* (Cke. & Ell.) Sacc. ('*theioidea*'), Syll. Fung. 8: 391, 1889.

≡ *Lachnella theiodea* (Cke. & Ell.) Sacc. in Seymour ('*theioidea*'), Host Index Fungi N. Am. p. 469, 1929 .

= *Mollisiella austriaca* Höhn., Ann. Mycol. 1: 396, 1903.

≡ *Pithyella austriaca* (Höhn.) Boud., Hist. Classif. Discom. Europe p. 125, 1907.

= *Hyphodiscus gregarius* Kirschst., Verh. Bot. Vereins Prov. Brandenburg 48: 44, 1907 (1906).

Apothecia turbinate to discoid when young, discoid to applanate at maturity, sessile, solitary to gregarious, 150-550 µm in diam; hymenium yellowish brown, warm brown to dark brown when dry; receptacle concolorous with hymenium, surface downy; with yellow powder covering receptacle surface and part of hymenium in some collections. Hairs present mostly at margin and flanks; light brown, cylindrical, often slightly inflated at apex, non-gelatinized, with granules mostly on the apical cell of hairs or less commonly covering the entire length, more or less thick-walled, 0-1 septate, 8-25 µm long, 2.7-4.0(-5.0) µm wide. Ectal excipulum of textura intricata, mixed with textura angularis at the base, 15-55(-75) µm thick; hyphae gelatinized, elongated, thick- and glassy-walled, subhyaline, slightly brownish towards the outside, 4.5-5.0 µm wide; hyphal walls 1-2 µm thick; many yellow crystals seen covering the receptacle surface when mounted in cotton blue-lactic acid or in water, crystals dissolved by 10% KOH. Medullary excipulum of textura intricata, less gelatinized, 13-20(-40) µm thick; hyphae slender, subhyaline to light brown. Subhymenium indistinguishable. Asci 8-spored, cylindrical with a tapered base, J+ in Melzer's reagent with or without 10% KOH pretreatment, walls somewhat thick at apex, 40-45 x 3.0-4.8 µm, with crozier at base. Ascospores uniseriate, spherical to subspherical, unicellular, hyaline, smooth-walled, uniguttulate, 2.2-3.3 µm in diam. Paraphyses filiform, septate, unbranched or branched only at base, 1.5 (-2.0) µm wide, not exceeding asci.

HABITAT: On fruit bodies of, or associated with, *Peniophora* sp. and other fungi on decorticated branches.

ILLUSTRATIONS: Kirschstein, W., Verh. Bot. Vereins Prov. Brandenburg 48: 45, Fig. 1907 (1906). Korf, R.P., Trans. Mycol. Soc. Japan 3: 49, Fig. 1, 1962. Dennis, R.W.G., Kew Bull. 17: 370, Fig. 68, 1963. This paper Figs. 1, 2.

SPECIMENS EXAMINED: **Austria**: On fruit bodies of *Peniophora cinerea* on decaying wood of *Fagus*, Georgenberg b. Purkersdorf, v. Höhnel, 27. II. 1903, FH-Herb. Höhnel #d. 5056 (holotype of *Mollisiella austriaca*).

United States: On decorticated *Rhus venenata* [associated with other fungi], New Jersey, Ellis 2956, (no date), K (holotype of *Peziza theiodea*), CUP-D 3820 (90-133) (isotype); on *Rhus venenata* [associated with another fungus], Vineland, New Jersey, Ellis, 6. III. 1878, CUP-D 8757 (90-134); on beech (?) stick [or on fruit bodies of *Peniophora* sp. on the same substrate], Sylvan, Washtenaw Co., Michigan, A.H. Smith, 9. IV. 1929, MICH, NY-Cummins 69, R. P. Korf Personal Herbarium (R.P.K.) 3100; [on fruit bodies of *Peniophora* sp.] on *Platanus occidentalis* L., Rte. 261 near Ohio-Breckinridge city line, Kentucky, R.T. Pennoyer 2707, 2. IV. 1961, R.P.K. 2943; on wood [and associated with another fungus], High Bridge, Indiana, R.T.

Pennoyer 2852, 26. VIII. 1961, R.P.K. 3277.

West Germany: On rotten wood of *Rhamnus frangula*, Stadtforst Rathenow a/H, W. Kirschstein, 19. III. 1905, B (holotype of *Hyphodiscus gregarius*).

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A NEW SPECIES OF HETEROTHALLIC TALAROMYCES

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SUMMARY

A new heterothallic fungus, *Talaromyces derxii* (anamorph: *Penicillium derxii*), was isolated from cultivated soil in Kurashiki City, western Japan. The species is characterized by the rapid growth at 37°C, deep greenish to pale orange colony reverse, grayish green ascomata, ellipsoidal and spinulose ascospores, bi- or terverticillate penicilli, and cylindroidal-fusiform conidia. Besides morphological differences, it clearly differs from the other *Talaromyces* species by its heterothallic sexual reproduction.

Cleistothecial Ascomycetes with *Aspergillus, Penicillium* and *Paecilomyces* anamorphs have been classified in the Trichocomaceae by most recent authors (Malloch and Cain, 1972, 1973; Benny and Kimbrough, 1980). As recently summarized by Eriksson and Hawksworth (1986), the family contains more than 18 genera due to the discovery of the teleomorphs of more and more *Aspergillus* and *Penicillium* species. In spite of this taxonomic diversity, the Trichocomaceae have proved to be almost uniformly homothallic, although individual isolates may vary widely in sexual potency. Only three exceptions were encountered; viz. *Emericella heterothallica* (Kwon, Fennell et Raper) Malloch et Cain (Raper and Fennell, 1965; Kwon and Raper, 1967), *Neosartorya fennelliae* Kwon-Chung et Kim (Kwon-Chung and Kim, 1974) and *N. spathulata* Takada et Udagawa (Takada and Udagawa, 1985). Their anamorphs are obviously assignable to *Aspergillus*. In 1925 and 1926, Derx published two preliminary reports, in which he presented strong evidence of heterothallism in an isolate designated, "*Penicillium luteum* (Zukal?) Wehmer *certissime*!" Because this was not confirmed by subsequent workers (Emmons, 1935; Raper and Fennell, 1952), the discovery of heterothallism in *Penicillium* has received very little attention (Raper and Thom, 1949; Pitt, 1979).

During our continuous survey of soil-borne ascomycetous fungi in Japan, an unusual species of *Talaromyces* resembling *T. bacillosporus* C.R. Benjamin (Stolk and Samson, 1972), but having ellipsoidal ascospores, was isolated in 1976. Recent experiments with 10 single germinating ascospore-isolates of this fungus that had only the anamorph (*Penicillium*) showed that there were two groups of self-sterile but cross-fertile isolates. Production of fertile ascomata in malt agar or oatmeal agar cultures by adequate crosses between the single-ascospore isolates clearly showed this fungus to be heterothallic. Although there are some minor morphological differences between the two groups (vide the description), all single-ascospore isolates in the same group resemble each other in growth characteristics and colony morphology, indicating a relatively high degree of stability. Thus, nearly 50 years after Derx's work, we have encountered evidence of heterothallism in ascosporic Penicillia. Unfortunately, questions have not yet been resolved concerning the correct identification of Derx's culture as representing "*Penicillium luteum* (Zukal?) Wehmer *certissime*." Derx (1926) stated that "This is the species in which I discovered heterothallism." For subcultures of *Penicillium luteum* NRRL 2102 and NRRL 2103 which were forwarded to him by Raper and Fennell in 1950, however, he had subsequently answered them that neither of these strains conformed with that which he investigated, and then Raper and Fennell (1952) concluded that "Derx may thus have worked with some strain possessing unusual and possibly unique cultural characteristics." No type specimen of Derx's fungus is also known to be preserved. Since the taxonomic treatment of the first heterothallic *Talaromyces* (Derx, 1925, 1926) is not entirely adequate by modern standards, and since Derx never distributed cultures of his fungus, our isolate is described here as a first heterothallic species of *Talaromyces* with a *Penicillium* anamorph.

Talaromyces derxii Takada et Udagawa, sp.nov. (Figs.1-9)

Stat. Anam. *Penicillium derxii* Takada et Udagawa, anam. sp.nov.

Fungus heterothallicus. Ascomata superficialia, discreta vel confluentia, celeriter maturescentia, sine ostiolo, mycelio laxo intertexto obtecta, alba vel griseo-

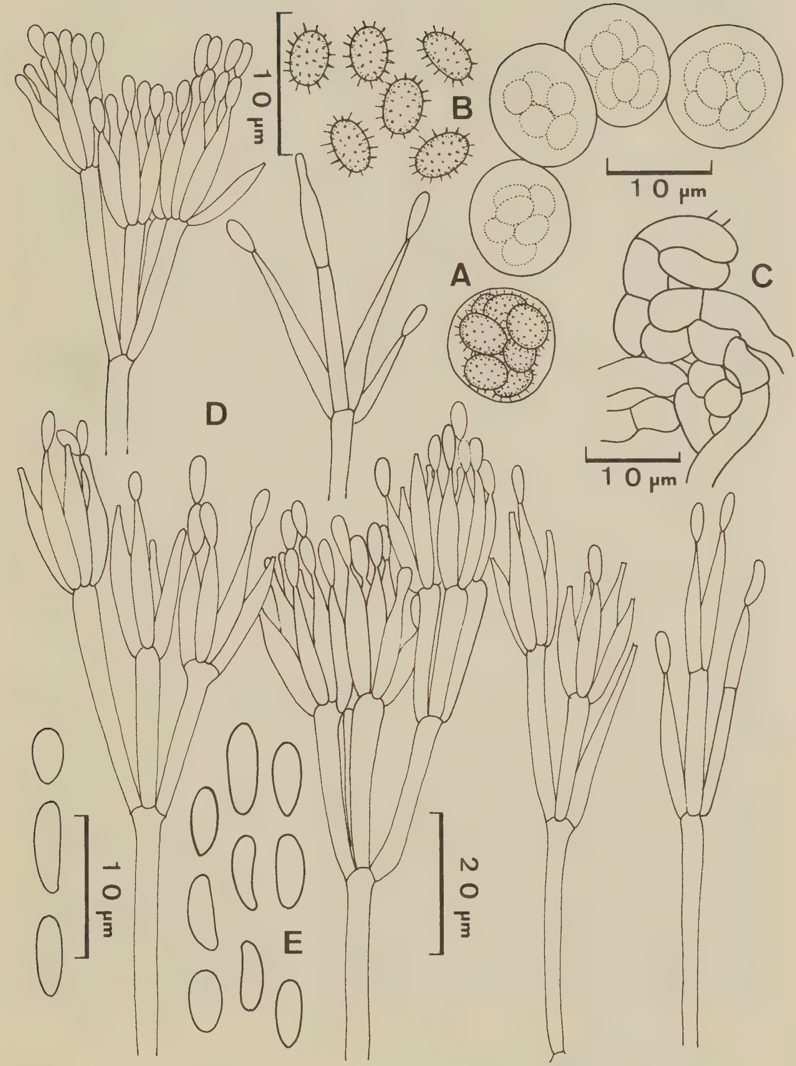

10 µm
B
10 µm
A
C
10 µm
D
10 µm
E
20 µm

Figure 1. *Talaromyces derxii* , NHL 2980-2982.
A. Asci. B. Ascospores. C. Coiled ascogonium.
D. Penicilli. E. Conidia.

viridia vel valde aeruginosa, globosa vel subglobosa, 160-320 µm; peridium laxum, 'textura intricata', ex hyphis hyalinis vel pigmentiferis, ramosis, septatis, saepe granulatis, 1.5-4 µm diam compositum. Asci catenulati breviter, 8-spori, globosi vel subglobosi,10-13 x 9-12 µm, postremo evanescentes. Ascosporae hyalinae vel pallide flavae, ellipsoideae, 3.5-5 x 2.5-3 µm, spinulosae.

Mycelium ex hyphis hyalinis vel flavo-brunneis, ramosis, septatis, ad septum saepe constrictis, levibus vel asperatis, 1.5-5 µm diam compositum, interdum aggregatum in funiculo. Conidiophora ex hyphis subsuperficialibus, hyphis aeriis vel fasciculis hypharum oriunda, hyalina, septata, levia, stipites 16-125 x 2.5-3.5 µm. Penicilli variabiles, vulgo biverticillati vel terverticillati, sed interdum monoverticillati. Rami 12-45 x 2-3 µm, leves. Metulae 2-4 verticillatae, 15-24(-30) x 2-4 µm, leves, appressae. Phialides 3-7 verticillatae, acerosae vel cylindricae, 10-20(-25) x 2-3.5 µm, leves. Conidia hyalina, fusiformia, cylindrica vel ellipsoidea, 4-8 x 1.5-3 µm, levia, in catenis implicatis connexa.

Coloniae in agaro Czapekii restrictae, floccosae, constantes ex mycelio basali coacto tenuiter et conidiis moderate vel copiose formantibus, albae vel obscure virides vel pistaceae; reversum atrovirens vel flavo-brunneum vel nigrum.

Coloniae in agaro 'Czapek-Yeast Autolysate' effusae, floccosae vel aliquantum velutinae, planae vel radiatim sulcatae, constantes ex mycelio basali coacto tenuiter et conidiis moderate formantibus, albae vel griseo-virides vel pallide aurantiacae; reversum griseo-viride vel pallide aurantiacum.

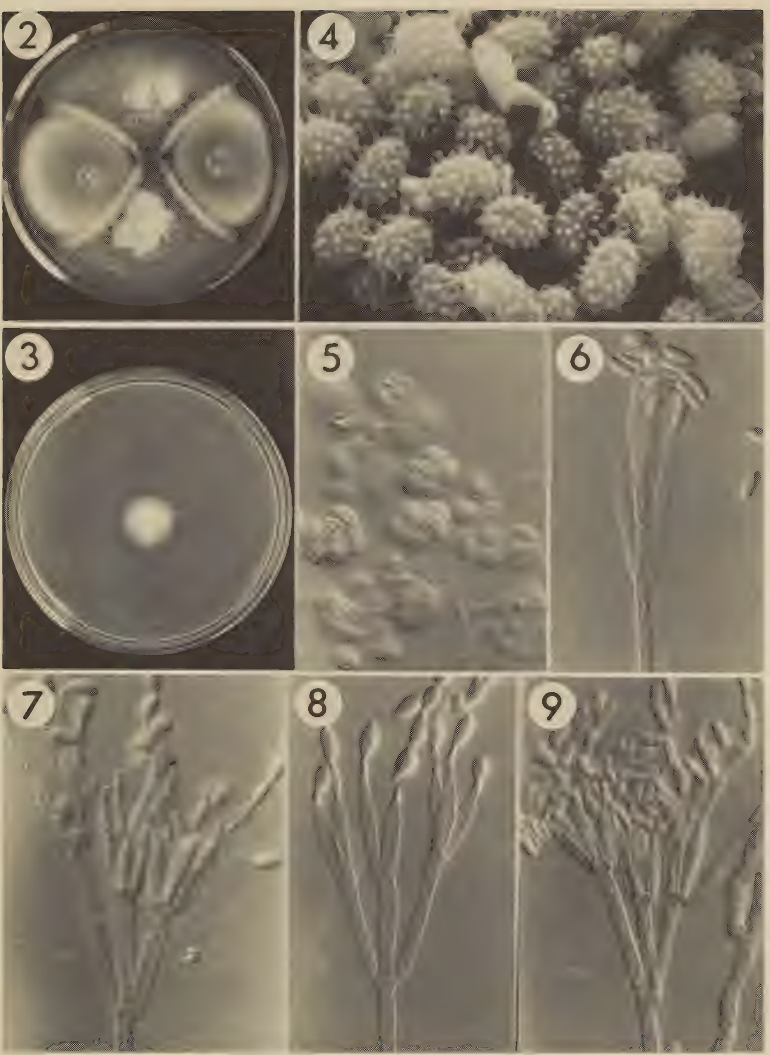
Coloniae in agaro maltoso effusae, floccosae, funiculosae vel gossypinae, planae, constantes ex mycelio basali coacto tenuiter cum conidiis moderate vel copiose formantibus et ex mycelio aerio sterili, albae vel griseo-virides; reversum atrovirens vel pistaceum.

Temperatura optima 30-37°C, crescere potest inter 16 et 40°C.

Holotypus NHL 2980, colonia exsiccata ex crusi NHL 2981 x NHL 2982, uterque ex solo sativo, Okayama, in Japonia, 1.v.1976,a M. Takada, isolata. In herb. NHL.

Etymology: After H.G. Derx.

Heterothallic. Ascomata superficial, discrete but often confluent, maturing within 7-10 days at 37°C, non-ostiolate, bounded by loosely interwoven mycelial overgrowth, white to grayish green or dark bluish green, globose to subglobose, 160-320 µm in diam; ascoma wall soft,



Figs. 2-9. *Talaromyces derxii* , NHL 2980-2982.

2. Paired culture of 'A' x 'a' on malt agar at 37°C, 7 days. (Top and bottom: 'A', NHL 2981; left and right: 'a', NHL 2982). x 1/2. 3. Colony of NHL 2981 on Czapek's agar at 37°C, 7 days. x 1/2. 4. Ascospores (SEM photograph). x 2500. 5. Asci. x 1200. 6-9. Conidial structures. 7 and 8: NHL 2981; 6 and 9: NHL 2982. x 750.

composed of hyaline or pigmented, branched, septate, often incrusted with granules, 1.5-4 µm diam hyphae, forming a 'textura intricata'; ascoma initials composed of ascogonial coils on swollen hypha. Asci borne in short chains, 8-spored, globose to subglobose, 10-13 x 9-12 µm, evanescent at maturity. Ascospores hyaline to pale yellow, ellipsoidal, 3.5-5 x 2.5-3 µm, spinulose with spines about 0.5 µm long.

Mycelium composed of hyaline or yellow to brown, branched, septate, often constricted at the septa, with smooth or roughened walls, more or less guttulate, 1.5-5 µm diam hyphae, sometimes forming a funicle. Conidiophores borne from subsurface hyphae, aerial hyphae or bundles of hyphae, stipes variable in length, 16-125 x 2.5-3.5 µm, hyaline, septate, with walls smooth, bearing terminal penicilli. Penicilli varying with strain, in NHL 2981 producing commonly biverticillate or terverticillate, rarely quaterverticillate or monoverticillate, in NHL 2982 rather simple, monoverticillate to biverticillate, sometimes terverticillate. Rami, when present, 12-45 x 2-3 µm, with walls smooth. Metulae 2-4 in the verticil, 15-24(-30) x 2-4 µm, with walls smooth, closely appressed, often with enlarged apices. Phialides 3-7 per metula, acerose to cylindroidal, 10-20(-25) x 2-3.5 µm, with walls smooth, closely appressed, often tapering abruptly to cylindroidal collula. Conidia hyaline, grayish green in mass, cylindroidal, fusiform, or ellipsoidal, sometimes curved, 4-8 x 1.5-3 µm, with walls smooth, borne in tangled chains up to 200-250 µm in length.

Colonies on Czapek's agar growing restrictedly, attaining a diameter of 15-20 mm in NHL 2981 or 10-13 mm in NHL 2982 within 7 days at 37°C, floccose, composed of a thin basal felt bearing moderate or abundant conidia, white to dull green (M.26D4, after Kornerup and Wanscher, 1978) or 'Pistachio Green'(Rayner, 1970); reverse deep green (M.25E8) or 'Dark Bluish Green'(Rayner) in NHL 2981, and yellowish brown (M.5E4), 'Greyish Sepia'(Rayner) or black in NHL 2982.

Colonies on Czapek Yeast Autolysate agar (CYA) growing rapidly, 65-69 mm in NHL 2981 or 42-46 mm in NHL 2982 within 7 days at 37°C, floccose or somewhat velvety, composed of a thin basal felt bearing moderate conidia, plain or radially furrowed, white to grayish green (M. 25C5) or 'Pistachio Green'(Rayner) in NHL 2981 and to grayish green (M.26B3), pale orange (M.5A3), 'Greenish Glaucous' or 'Salmon'(Rayner) in NHL 2982; exudate clear in small droplets; odor moldy; reverse grayish green

(M.25C5), pale orange (M.5A3), 'Pistachio Green' or 'Salmon'(Rayner) in NHL 2981, and light orange (M.5A5) or 'Ochreous'(Rayner) in NHL 2982.

Colonies on malt agar spreading broadly, 67-80 mm in NHL 2981 or 60-64 mm in NHL 2982 within 7 days at 37°C, floccose, funiculose or cottony, composed of a thin basal felt with a limited growth of sterile aerial mycelium and moderate or abundant conidia, plain, with color as on CYA, developing numerous ascomata in a layer at the contacted zone only after appropriate pairings; ascomata white at first, then overgrown by a loose network of pigmented hyphae, grayish green (M.25C6) or 'Bluish Green'(Rayner); reverse deep green (M.25E8) or 'Pistachio Green'(Rayner).

Colonies on oatmeal agar spreading broadly, up to 85 mm or more in 12 days at 37°C, floccose in NHL 2981 or velvety in NHL 2982, composed of a thin basal felt with abundant conidia, dull green (M.28D3-4, 27D4), 'Smoke Grey' or 'Pistachio Green'(Rayner), producing numerous ascomata in a layer at the contacted zone after pairings as on malt agar; reverse deep green (M.25E1) to pale orange (M.5A3), or 'Dark Bluish Green' to 'Rosy Buff' (Rayner).

Colonies on cornmeal agar growing rapidly, very thin, with vegetative mycelium submerged, producing scattered conidia.

Optimum temperature for growth is 30-37°C with a temperature range between 16 and 40°C.

Isolation: cultivated soil, Higashitomii, Kurashiki City, Okayama Prefecture, Japan, May 1, 1976, coll. M. Takada.

Holotype: The type of *Talaromyces derxii* is a dried culture of NHL 2981 x 2982 preserved in NHL 2980. Subcultures of the 'A'(NHL 2981) and 'a'(NHL 2982) mating types are deposited in the American Type Culture Collection.

This fungus is easily distinguished from all described species of *Talaromyces* (Stolk and Samson, 1972; Samson and Abdel-Fattah, 1978; Pitt, 1979) by its heterothallic sexual reproduction. The greenish colony appearance and the slender penicilli with cylindroidal conidia of this fungus, resembles *T. bacillosporus* (anamorph: *Geosmithia swiftii* Pitt), but differs by ellipsoidal ascospores, rather complex penicilli with all elements smooth-walled, and larger conidia (4-8 x 1.5-3 µm vs. 4-5 x 1-1.2(-1.5) µm in *G. swiftii*). Although the *Penicillium* anamorph of this fungus resembles *Geosmithia* (Pitt, 1979) in the production of appressed penicilli with cylindroidal phialides and conidia, the phialides are always smooth-walled.

This appears to be the first report of heterothallism in the Trichocomoideae (the subfamily lacking bivalvate ascospores (Malloch, 1985)).

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STUDIES IN THE GENUS PHOMA. X. CONCERNING PHOMA EUPYRENA, AN UBIQUITOUS, SOIL-BORNE SPECIES.

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ABSTRACT

Phoma eupyrena Sacc., an ubiquitous, chlamydospore-forming, soil-inhabiting species is described and illustrated. Its characteristics when grown on agar media are documented, as is the anatomy of its pycnidial wall. Distinctions between it and species of *Phoma* Sacc. with which it can be confused are noted.

INTRODUCTION

Ten species currently classified in the genus *Phoma* are known to produce chlamydospores. Of these, only three bear unicellular chlamydospores; namely *P. eupyrena*, *P. medicaginis* Malbr. & Roum., and *P. pinodella* (L.K. Jones) Morgan-Jones & Burch. The latter two, in addition to five dictyochlamydospore-bearing species, *P. americana* Morgan-Jones & White, *P. glomerata* (Cda) Wollenw. & Hochapf., *P. jolyana* Pirozynski & Morgan-Jones, *P. pomorum* Thümen, and *P. sorghina* (Sacc.) Boerema, Dorenbosch & van Kesteren, have been previously treated in this series of papers (Morgan-Jones and White, 1983; White and Morgan-Jones, 1983, 1986, 1987a, 1987b, Morgan-Jones and Burch, 1987a, 1987b). The present paper describes *P. eupyrena*.

The binomial *Phoma eupyrena* has, historically, been applied predominantly to isolates found in association with potato tubers. It is now known, however, to occur commonly in soil (Domsch and Gams, 1970; Domsch, Gams and Anderson, 1980), to have a wide host range, and a cosmopolitan distribution. The fungus was originally described by Saccardo (1879) from stems of potato. Although he did not note the presence of chlamydospores, their production has been accepted as an important differentiating criterion for it in subsequent work. It was isolated from potato tubers by Wollenweber (1920) and noted to be the causal organism of blackish pimples on skins. He reported his strain to induce rotting of apple and cucumber, as well as potato, and to produce typical chlamydospores. Wollenweber and Hochapfel (1936) did not, however, list *P. eupyrena* among *Phoma* species causing minor fruit rots. In subsequent use of the name *Phoma eupyrena*, the qualifications "as interpreted by Wollenweber" or "sensu Wollenweber" were added (Dennis, 1946; Malcolmson,

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1958; Boerema and van Kesteren, 1962; Kranz, 1963), indicating uncertainty as to whether or not the fungus studied by Wollenweber was identical to that of Saccardo (1879). Dennis (1946) described two closely similar strains (designated 17 and 18 and constituting his Group VII among *Phoma* isolates) isolated from tissue of potato tubers showing superficial necrosis. Both produced abundant and characteristic chlamydospores. Strain 18, received from A.R. Wilson, had been identified as *P. eupyrena* by G.R. Bisby. Dennis, however, doubted that Wollenweber's fungus (conidia 4-6 X 1.7-2.3 um) was identical with Saccardo's (conidia 4 X 1.5 um). Uncertainty about Wollenweber's application of the name *P. eupyrena* was further increased when Malcolmson (1958) failed to find chlamydospores in a specimen, labelled "*P. eupyrena* f. *dulcamarae*" (collected on *Solanum dulcamara* L. in the U.S.A. in 1889 by C.E. Fairman), in Saccardo's herbarium. This was not, however, the type material. The fungus on *S. dulcamara*, also issued by C. Roumeguēre in his *Fungi gallici exsiccati* no. 2116 as *P. eupyrena*, and isolated from this host by Kranz (1963), is now thought to be *Phoma exigua* Desm. var. *exigua* (Boerema, 1976). It occurs commonly on this host but is also known from potato where it is associated with a dry rot or gangrene disorder [the names *Phoma solanicola* Prill. & Del. and *Phoma tuberosa* Melhus, Rosenbaum & Schultz have also been applied to it; both now accepted as synonyms of *P. exigua*]. Examination of the holotype of *P. eupyrena*, which is extant [on stems of *Solanum tuberosum* L., collected near Saintes (Charente-Infērieur), P. Brunaud (without date), Herb Sacc. "39", PAD], reveals characteristics that agree closely with Wollenweber's interpretation, including possession of chlamydospores and conidia measuring 3.4-5.1 X 1.7-2.6 um (Dorenbosch, 1970). The binomial *P. eupyrena* has, therefore, for the most part, been correctly applied in the past but the qualification "sensu Wollenweber" is superfluous.

Phoma eupyrena is sometimes associated with superficial necroses of potato tubers (Boyd, 1972) and it may be implicated as a causal organism of seedling damping-off in various plants (Hampel, 1972). It is, however, considered to be predominantly a secondary invader of plant tissues (Domsch and Gams, 1970; Boerema, 1976). In addition to *P. eupyrena*, as noted in part above, a number of binomials in the genus *Phoma* have, in the past, been applied to fungi associated with potato. These include *P. destructiva* Plowright, *P. exigua*, *P. foveata* Foister, *P. solanicola*, and *P. tuberosa*. *Phoma foveata* was considered by Boerema (1967) to be a pigment-producing variety of *P. exigua* and reclassified in that species as *P. exigua* var. *foveata* (Foister) Boerema. To facilitate correct identification of *P. eupyrena*, a new comprehensive description of it is offered here. The characteristics by which it can be distinguished from *Phoma exigua* vars. *exigua* and *foveata*, both of which cause gangrene of potatoes, and *P. pomorum*, with which it might be confused when the latter fails to form dictyochlamydospores, are documented.

In this series of papers the reader is reminded that many *Phoma* form-species are variable in their *in vitro* cultural characteristics. Differences are often found between strains from various sources and between single conidial isolates of individual strains. An attempt is made to determine the range of variation but caution must be exercised in applying some of the information since descriptions are prepared from limited number of isolates.

We are using the term "chlamydospores" *sensu amplo* for convenience, perpetuating the practice of previous authors of *Phoma* descriptions, to designate swollen, thick-walled, darkly pigmented elements formed by modification of

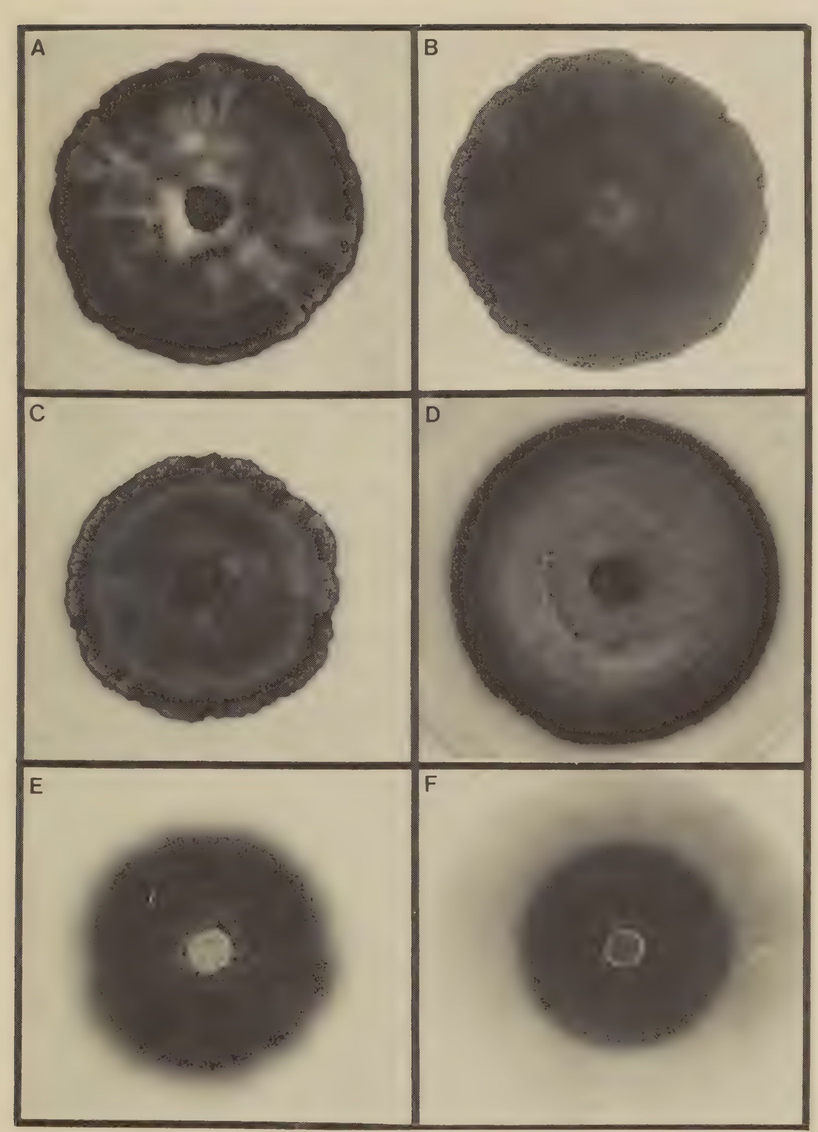


PLATE 1. *Phoma eupyrena*. A, 14-day-old colony on PDA at 25C; B, reverse of same; C, 14-day-old colony on PDA at 25C [A and C, single-conidial isolates of same strain: ATCC 22238]; D, 14-day-old colony on PDA at 20C; E, 14-day-old colony on MEA at 25C; F, 14-day-old colony on MEA at 20C.

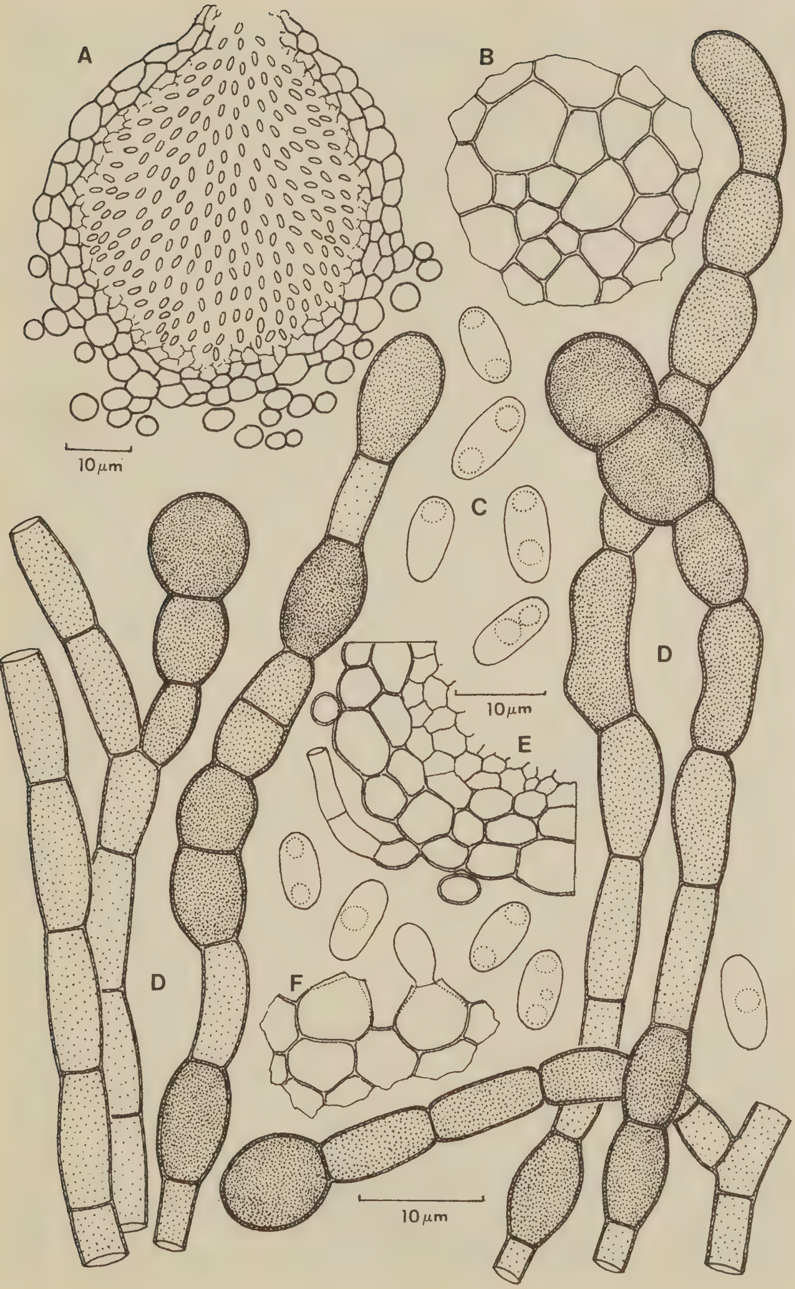
terminal or intercalary hyphal cells by internal deposition of additional wall material. We are, of course, aware that these structures do not correspond to those for which the term was originally coined by de Bary (1859). As Hughes (1985) noted, true chlamydospores, *sensu* de Bary, which are formed endogenously within preexisting cells, are not known to occur in the Ascomycotina or Deuteromycotina.

TAXONOMIC PART

Phoma eupyrena Sacc., Michelia 1: 525, 1879 (Plates 1 and 2, figure 1).

Colonies on potato dextrose agar (PDA) [Difco] somewhat variable in appearance and coloration, generally lanose but usually becoming densely felted after two to three weeks, pale dove gray to olivaceous gray to charcoal gray, becoming brownish to blackish and irregularly pulvinate at the center with age. Colonies either more or less evenly colored in broad concentric zones or irregularly mottled or with indistinct and variously-sized sectors, attaining a diameter of 44-48 mm at 25C after 10 days, with an irregularly indented or slightly scalloped margin. Ten-day-old colonies on PDA grown at 20C, 65 mm in diameter, lanose, grayish olivaceous in the center, with a broad (15-16 mm wide), somewhat felted, dove gray to charcoal gray outer zone, becoming progressively darker towards the periphery with a narrow (2 mm wide), paler, even margin of mostly immersed mycelium; reverse uniformly dark gray to black. Colonies on malt extract agar (MEA) [Difco] densely striate in the form of olivaceous, mostly immersed, radially-arranged mycelial strands, attaining a diameter of 43 mm at 25C after 10 days. Ten-day-old colonies on MEA grown at 20C, 60 mm in diameter, olivaceous green, with very little aerial mycelium, immersed mycelium organized as numerous radial strands, with a broad (5 mm wide), pale margin. Colonies on cellulose agar sparse. Mycelium composed of two main types of hyphae: hyaline to subhyaline, smooth, thin-walled, branched, septate, 2-2.5 um wide; and pale brown, smooth, thick-walled, branched, septate 2.5-4 um wide. The latter hyphae are often arranged in parallel strands and sometimes become irregularly inflated in older cultures. Chlamydospores produced abundantly on all three media, arising singly or in chains, terminal or intercalary, where intercalary barrel-shaped, where terminal ellipsoid to subglobose, smooth, thick-walled, brown, 4-12 um in diameter. Pycnidia solitary or sometimes confluent, often initiated from hyphal strands, subglobose, without a pronounced neck, pale to dark brown, pseudoparenchymatous, indistinctly uniostiolate, glabrous or, more often, loosely covered with wide, pale brown hyphae and chlamydospores, 165-225 um in diameter. Pycnidial wall composed of more or less isodiametric or slightly elongate cells of two types; an outer layer, two to three cells thick, of variously sized, thick-walled, brown cells and an inner layer, two to three cells thick, of thin-walled, subhyaline to hyaline cells. The inner layer of cells disintegrates soon after conidiation. Conidiogenous cells phialidic, hyaline, simple, smooth-walled, ampulliform to doliiform, with a thickened periclinal wall, borne from pycnidial wall cells lining the venter. Conidia enteroblastic, hyaline, smooth, oblong with obtuse ends to ellipsoid, straight or very slightly curved, unicellular, guttulate (often biguttulate), 3-6 X 1.5-3 um. Exuding conidial masses whitish to pale gray.

FIGURE 1. *Phoma eupyrena*. A, vertical section of pycnidium; B, surface view of pycnidial wall; C, conidia; D, chlamydospores; E, portion of pycnidial wall in section; F, conidiogenous cells.


A
B
10 μm
C
D
10 μm
E
D
F
10 μm

Plurivorous, particularly on plant roots and decaying organic matter, soil-inhabiting; probably cosmopolitan.

Collections examined: isolated from soil, The Netherlands, CBS 527.66, IMI 45944, ATCC 22238; isolated from *Phaseolus vulgaris* L., Martinesse, Noordoostpolder, The Netherlands, 1978, PD 78/745.

DISCUSSION

Sutton (1980) reports that approximately a hundred collections of this taxon from thirty different host genera are housed in the herbarium at the CAB International Mycological Institute. Although originally described from potato, Gams *et al*. (1969) isolated it frequently from soils in which potatoes had never been grown.

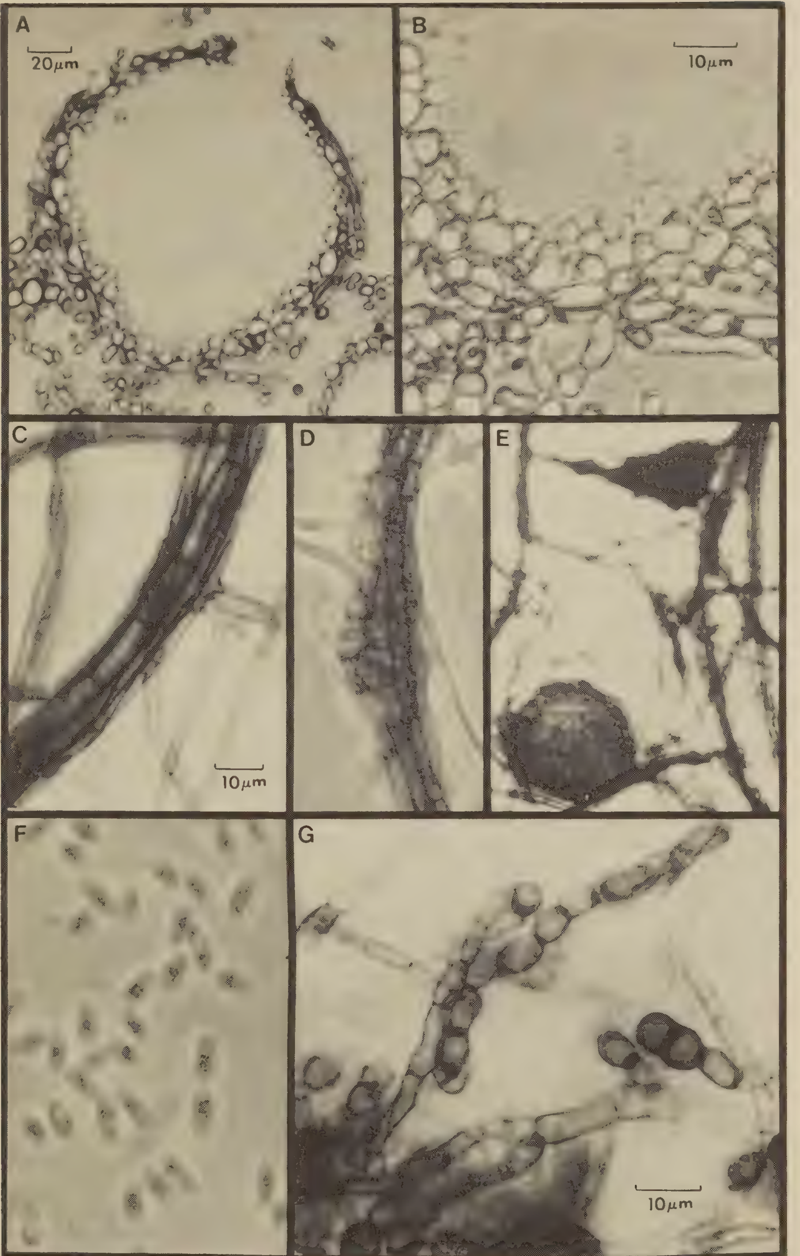
Isolates of *Phoma eupyrena* grow faster at 20C than at 25C and, on PDA, colonies grown at the former temperature have a more even and consistent appearance (cf. Plate 1A, 1D). Single-conidial subisolates of a given strain vary somewhat in their growth rates (cf. Plate 1A, 1C). Colonies grown on MEA at 25C tend to be more prominently striate than those grown at 20C, particularly at their margin (cf. Plate 1E, 1F). One of the isolates studied (ATCC 22238) does not produce pycnidia as readily as the other, possibly because of *in vitro* deterioration. Intensity of chlamydospore production varies among individual isolates and is affected by the sugar content of the medium (Malcolmson, 1958). The chlamydospores, which are not dissimilar in appearance to those of the soil-borne fungus *Verticillium nigrescens* Pethybr., when mature sometimes disarticulate rather readily in the manner of species of *Scytalidium* Pesante. Conidia of *P. eupyrena* are predominantly biguttulate as in alpha-conidia of *Phomopsis* (Sacc.) Sacc.

Phoma eupyrena and another soil-borne fungus, *P. pomorum*, though similar in that they possess chlamydospores and anatomically somewhat similar pycnidia, can be distinguished by a number of characteristics. Although *P. pomorum* does not invariably form dictyochlamydospores and frequently only in old cultures, the shape of its individual non-septate chlamydospores is different from those of *P. eupyrena*, being subglobose or globose. The appearance of the two species in culture is also quite different, particularly on MEA (cf. White and Morgan-Jones, 1986). Lack of chlamydospores in *P. exigua*, which is also soil-borne, colony characteristics and possession of somewhat larger, occasionally septate, conidia serve to easily differentiate that species from *P. eupyrena*.

ACKNOWLEDGMENTS

We thank Dr. M.E. Noordeloos, Plantenziektenkundige Dienst, Wageningen, The Netherlands, for providing us with the isolate of *P. eupyrena* from *Phaseolus vulgaris*. Dr. J. Leland Crane, State History Survey Division, Illinois Department of Energy and Natural Resources, reviewed the manuscript.

PLATE 2. *Phoma eupyrena*. A, vertical section of pycnidium; B, portion of pycnidial wall in section; C, hyphal rope; D, pycnidial initial originating from hyphal rope; E, hyphae, hyphal ropes and developing pycnidia; F, conidia; G, chlamydospores.


A
20μm
B
10μm
C
10μm
D
E
F
G
10μm

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CONSIDERATIONS ABOUT THE VALIDITY OF THE GENUS CYLINDROTRICHUM Bonorden.

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ABSTRACT

The validity of the genus Cylindrotrichum is discussed. In order to make clear certain generic concept the genus is redefined. A complete list of 11 accepted species of the genus is provided.

During the last years the genus Cylindrotrichum Bonorden has been revised and analysed by different authors (Gams and Holubová-Jechová, 1976; Morgan-Jones, 1980; DiCosmo, Berch and Kendrick, 1983). At the same time new species were described being their number enlarged. This fact caused the limits of the genus to be confounded and lead DiCosmo et al. (op. cit.) to rearrange the disposition of all the species of Cylindrotrichum in three genera: Kylindria DiCosmo, Berch et Kendrick and Xenokylindria DiCosmo, Berch et Kendrick, two new genera, and a third one Chaetopsis Greville whose concept was extended in order to include the remaining species. Difficulties in delimitating these genera and the allied genera arise from this new disposition.

Because of what has been stated above, we consider it necessary to make clear certain generic concepts, this been the purpose of the present paper.

The genus Cylindrotrichum was erected by Bonorden in 1851 and of Bonorden's four original species only one, C. oligospermum (Corda) Bonorden, chosen by Hughes (1958) as lectotype for the genus, was included. The remaining three names were excluded for different reasons (Morgan-Jones, 1980).

DiCosmo et al. (op. cit.) transferred C. oligospermum to the genus Chaetopsis, whose concept was extended. Chaetopsis was erected by Greville in 1825, being C. grisea (Ehrenberg) Saccardo the type species. This species has setiform conidiophore branched near the base, each branch bearing polyphialidic conidiogenous cells. The change in the sense of the genus carried out by DiCosmo et al. (op. cit.) means such an enlargement that this genus can superpose itself with other genera such as Chloridium and Dictyochaeta. This is so because DiCosmo et al. (op.

cit.) included forms with or without setas and unbranched conidiophore, so that the conidiogenous cells are borne at the top of the sparse conidiophores.

According to the type species *C. oligospermum* (Corda) Bonorden, the genus *Cylindrotrichum* is defined as follows: unbranched conidiophore with terminal polyphialidic sympodial conidiogenous cells.

The article 52 of the International Code of Botanical Nomenclature (1983) states: "When a genus is divided in two or more genera, the generic name, if correct, must be retained for one of them...". For that reason we consider as incorrect the proposal of DiCosmo et al. because the type species can be included in the genus *Cylindrotrichum* with species such as *C. fasciculatum* Mercado Sierra, *C. hennebertii* Gams et Holubová-Jechová, and *C. prosbosciophorum* (DiCosmo, Berch et Kendrick) Arambarri et Cabello. On the other hand, *C. clavatum* Gams, *C. ellisii* Morgan-Jones, *C. triseptatum* Matsushima and *C. zygnöellae* (Höhnel) Gams et Holubová-Jechová can also be considerer as species of the genus *Cylindrotrichum*, since the presence of multiple and single conidiogenous loci in the phialide can occur within one genus (Gams et al., 1985).

According to the considerations mentioned before, the genus *Cylindrotrichum* can be defined as follows: conidiophore erect and unbranched; conidiogenous cells terminal with single or multiple conidiogenous loci produced by sympodial or percurrent proliferation. *C. proliferum* Matsushima should also be included in this definition of the genus.

We are introducing now a complete list of 11 accepted species of the genus *Cylindrotrichum*:

1. *C. oligospermum (Corda) Bonorden, Handb. allyem. Mykol. 98, 1851.*
   Menispora oligosperma Corda, Icon. Fung. 2: 12, 1838.
   Chaetopsis oligosperma (Corda) DiCosmo, Berch et Kendrick, Mycologia 75(6): 962, 1983.

2. *C. proliferum Matsushima, Icones Microfungorum a Matsushima Lectorum: 47-48, 1975.*
   Xenokylindria prolifera (Matsushima) DiCosmo, Berch et Kendrick, Mycologia 75(6): 971, 1983.

3. *C. triseptatum Matsushima, Icones Microfungorum a Matsushima Lectorum: 48, 1975; non C. triseptatum Ellis, More Dematiaceous Hyphomycetes: 470, 1976.*
   Kylindria triseptata (Matsushima) DiCosmo, Berch et Kendrick, Mycologia 75(6): 971, 1983.

4. *C. clavatum Gams in Gams & Holubová-Jechová, Stud. Mycol. 13: 54, 1976.*
   Kylindria clavata (Gams in Gams & Holubová-Jechová) DiCosmo, Berch et Kendrick, Mycologia 75(6): 970, 1983.

5. *C. hennebertii Gams et Holubová-Jechová, Stud. Mycol.*

192 line 12 for *A. osmophila* read *Ascosphaera osmophila*
437 line 31 for C. read Cylindrotrichum
467 line 23 for Tricothelium read Trichothelium

13: 50, 1976.
Chaetopsis hennebertii (Gams et Holubová-Jechová) DiCosmo, Berch et Kendrick, Mycologia 75(6): 970, 1983.

6. *C. zygnöellae (Höhnel) Gams et Holubová-Jechová, Stud. Mycol. 13: 53, 1976.*
   Acrotheca zygnöellae Höhnel, Sber. K. Akad. Wiss. Wien, Math.-nat. Kl. 118:332, 1909.
   Kylindria zygnöellae (Höhnel) DiCosmo, Berch et Kendrick, Mycologia 75(6): 971, 1983.

7. *C. ellisii Morgan-Jones, Mycotaxon 5: 490, 1977.*
   C. triseptatum Ellis, More Dematiaceous Hyphomycetes: 470, 1976, non C. triseptatum Matsushima, Icones Microfungorum a Matsushima Lectorum: 48, 1975.
   Kylindria ellisii (Morgan-Jones) DiCosmo Berch et Kendrick, Mycologia 75(6): 970, 1983.

8. *C. oblongisporum Morgan-Jones, Mycotaxon 5 (2): 487, 1977.*
   Kylindria oblongispora (Morgan-Jones) DiCosmo, Berch et Kendrick, Mycologia 75(6): 971, 1983.

9. *C. fasciculatum Mercado Sierra, Acta Botánica Cubana 16: 5, 1985.*

10. *C. excentricum (Bhat et Sutton) Cabello et Arambarri, comb. nov.*
    Kylindria excentrica Bhat et Sutton, Trans. Br. Mycol. Soc. 84(4): 728, 1985.

11. *C. probosciophorum (DiCosmo, Berch et Kendrick) Arambarri et Cabello, comb. nov.*
    Chaetopsis probosciophora DiCosmo, Berch et Kendrick, Mycologia 75(6): 962, 1983.

C. curvatum Morgan-Jones (Morgan-Jones, 1980) and C. helisciforme Marvanová (Marvanová, 1979) are two species that would need a quite detailed review; the first one could be a species of Dictyochaeta as DiCosmo et al. propose (although they use Codinaea as generic name) while the second one could be one species of the genus Heliscus; nevertheless, the conidia do not coincide with those of the genus.

We conclude that Cylindrotrichum is a valid genus with 11 species; we are not taking into account the genera Kylindria and Xenokylindria limitating Chaetopsis to the original concept. Nevertheless assuming the similarities and difficulties the allied genera present we consider it necessary to carry out a much deeper taxonomy work.

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We thank Dr. Irma Gamundí and Dr. Jorge Wright for their critical review of this manuscript.

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STUDIES IN CORTICIACEAE (BASIDIOMYCETES)
NEW SPECIES AND NEW COMBINATIONS

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Abstract. Phlebia ryvardenii Hallenb. & Hjortst. and Sistotrema quadrisporum Hallenb. & Hjortst. are described as new species on material from N. Europe and Spain. The combinations Steccherinum albo-fibrillosum (Hjortst.& Ryv.)Hallenb.& Hjortst. and S. queletii (Bourd.& Galz.) Hallenb.& Hjortst. are proposed.

PHLEBIA RYVARDENII Hallenb. & Hjortst. spec. nov.

Basidioma resupinatum, plus minus stramineum, distincte odontioides; aculeis fimbriatis, circiter 0.5 mm longis, 3-4/mm, aggregatis; margo gracilis, pallescens, interdum abruptus. Systema hyphale monomiticum, hyphae basales crassitunicatae, 3.5-4 µm latae, plus minus tumescentes, tum 8(-10) µm latae, hyphae ceterae tenuitunicatae, 2.5-3.5 µm, omnes fibulatae. Cystidia sparsa, projecta, tenuitunicata, levia, hyalina, 40-60 x 4 µm. Basidia anguste clavata, leviter sinuosa, 15-20 x 4.5(-5) µm, 4 sterigmatibus; sporis ellipsoidibus, tenuitunicatis, hyalinis, levibus, 4.5-5 x 2.5(-3) µm, neque amyloidibus, neque dextrinoidibus et cyanophilis.

Holotypus: Sweden. Medelpad, Haverö par., Björntjärnås Forest Reserve, on Picea abies. 17.IX.1986, leg. Leif Ryvarden 24081 (GB). Isotypus: (O). Paratypi: Spain. Huesca Prov., Ordesa Nat. Park, 1500 m.s.m., on Pinus, 9.XI.1977, leg. Leif Ryvarden 15009, 15031 (GB and O).

Etymology: In honour of our friend, Leif Ryvarden, who has collected all hitherto known specimens of this new species.

Basidiome resupinate, closely adnate, crustose, cracking conspicuously when dried, straw-coloured or pale ochraceous, densely odontioid, with the aculei about 0.5 mm long and 3-4/mm, crowded, apically fimbriate; subiculum whitish, thin (0.1-0.2 mm); margin indeterminate, thinning out, sometimes abrupt.
Hyphal system monomitic, basal hyphae thick-walled, partly encrusted, irregularly branched, 3.5-4(-5) µm wide, sometimes swelling considerably in KOH and then up to

8(-10) um wide, next to the substratum parallely arranged, elsewhere more or less vertical and intermingled with thin-walled hyphae; subhymenial tissue dense, consisting of thin-walled hyphae with shorter cells, about 2.5-3.5 µm wide, all hyphae with clamps.

Cystidia few and mainly in the upper part of the aculei, 40-60 x 4 µm, smooth and hyaline, projecting as much as 20-30 µm above the basidia, apically obtuse and with a basal clamp.

Basidia short-clavate, slightly sinuous, 15-20 x 4-4.5 (-5) µm, with 4 sterigmata and a basal clamp.

Spores ellipsoid to narrowly ellipsoid, 4.5-5 x 2.5(-3) µm, thin-walled, smooth, adaxial side often slightly concave, inamyloid, indextrinoid, and acyanophilous.

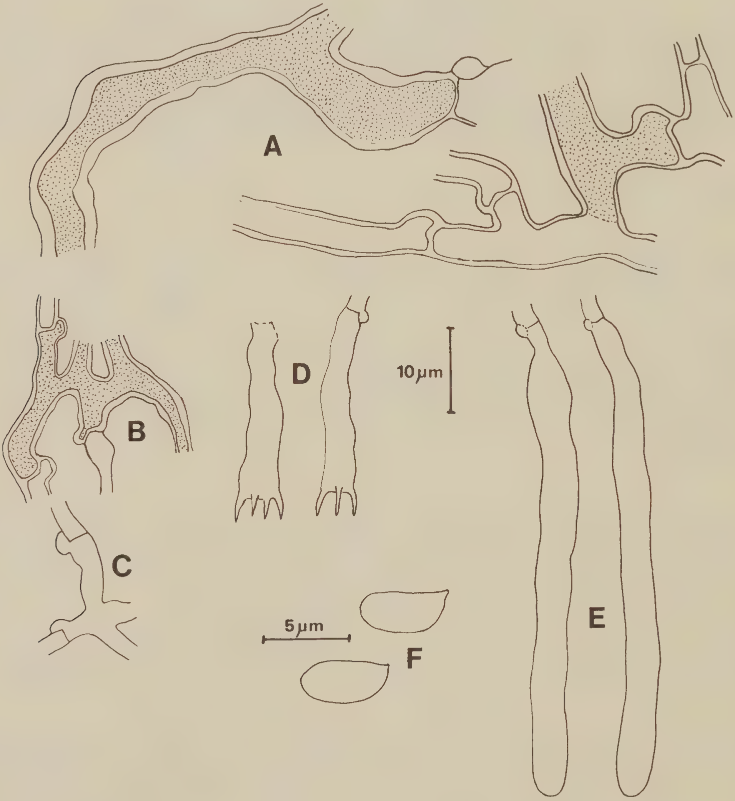

Fig. 1. Phlebia ryvardenii. A) subicular hyphae, swelling in KOH, B) context hyphae, swelling in KOH, C) subhymenial hyphae, D) basidia, E) cystidia, F) spores. - Holotypus.

Remarks. Macromorphologically this species shows affinity with some species of *Hyphodontia* (especially in the section *Ellipsosporae* Parm.) or *Odonticium* due to the odontioid fruitbody. However, the species resembles *Phlebia* s.l. in certain microfeatures, especially the narrow basidia and relatively small spores fit the modern, though wide, interpretation of this genus.

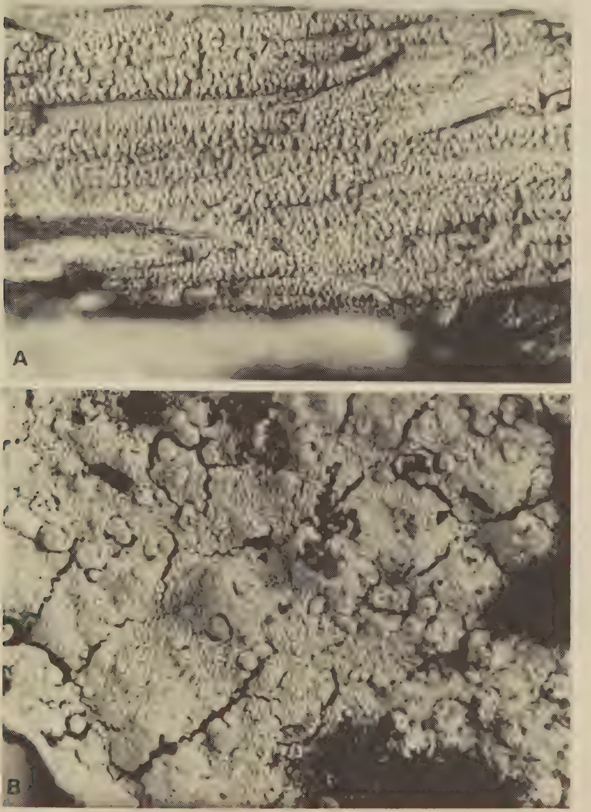

Fig. 2. Basidiocarps of A) *Phlebia ryvardenii* (X 4). - Coll. L. Ryvarden 24081. B) *Sistotrema quadrisporum* (X 4,7). - Coll. N. Hallenberg 10506. Photo Ellen Hansson.

SISTOTREMA QUADRISPORUM Hallenb. & Hjortst. spec. nov.

Basidioma resupinatum, dense adnatum, tenue, hymenio albescenti, grandinioide; aculeis circiter 0,2 mm longis, usque ad 7/mm; margine indeterminato. Systema hyphale monomiticum; hyphae tenuitunicatae, 2-3.5 µm latae, fibulatae. Cystidia nulla. Basidia urniformia, 10-20 x 5.5-7 µm, 4 sterigmatibus; sporae ellipsoideae, subreniformes, 5.5-7 x 3.3-4 µm, tenuitunicatae, leves, non-amyloides, binucleatae.

Holotypus: Spain. Santander Prov., ca 5 km S of Cavadonga, on Alnus incana. 14.XI.1977, leg. Leif Ryvarden 15372 (GB). Paratypus: Denmark. Jutland, Djursland Prov. Mols Bjerge, near Lake Bogens, on Salix. 3.IX.1987, leg. Nils Hallenberg 10506 (GB).

Basidiome resupinate, closely adnate, thin, white to slightly yellowish, hymenium continuous - porulose, grandinioid, aculei minute (ca 0,2 mm), rounded, rather scattered to crowded (up to 7/mm) in well developed parts, margin indeterminate, thinning out.
Hyphal system monomitic, hyphae 2-3.5 µm wide, constantly with clamps, with thin but distinct walls, intermingled with lots of crystalline material, densely branched and tightly packed in the thin subiculum.
Cystidia none.
Basidia urniform, 15-20 x 5.5-7 µm, apical part 3.5-4 µm wide, with 4 sterigmata and a basal clamp.
Spores ellipsoid - subreniform, adaxial side usually straight but may be slightly concave, 5.5-7 x 3.3-4 µm, thin-walled, smooth, inamyloid, binucleate.

Remarks. This species was first noticed in Eriksson et al (1984) as *Sistotrema* sp. Ryvarden 15372. Later, it was collected by Hallenberg in Denmark, where it covered the underside of a lying log of *Salix* in a swamp.
Under the lens *S. quadrisporum* is very similar to *S. brinkmannii* (Bres.)John Erikss. and the two species are certainly very closely related. Under the microscope *S. quadrisporum* is easily distinguished by its 4 sterigmate basidia and larger spores, which are also binucleate.

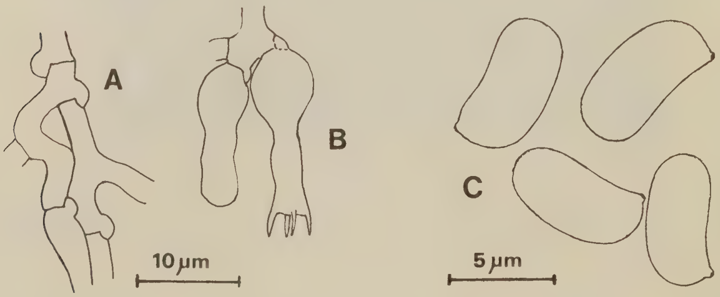

Fig. 3. *Sistotrema quadrisporum*. A) Context hyphae, B) basidia, C) spores. - Holotypus.

Sistotrema intermedium Hjortst. and S. sernanderi (Litsch.)Donk also have 4 sterigmate basidia. None of these is, however, grandinioid, which make them easily separated from S. quadrisporum. Moreover, S. intermedium differs by having navicular spores and S. sernanderi has gloeocystidia. Sistotrema eximum (Jacks.)Ryv. & Solh. has spores of similar size and shape as S. quadrisporum, but the fruitbodies are smooth and basidia usually bisterigmate.

STECCHERINUM QUELETII (Bourd.& Galz.)Hallenb.& Hjortst. comb. nov. Basionym: Odontia queletii Bourd. & Galz., Bull. Soc. Mycol. France 30:270, 1914 sub nom. nov. Odontia farinacea Quel., Fl. Mycol. France p. 435, 1888; nec Odontia farinacea (Pers.:Fr.) Cooke & Quel. 1878.

Although this species is monomitic, or rather lacking skeletal hyphae in the subiculum, it fits the generic description of Steccherinum (type species: Hydnum ochraceum Pers.:Fr.) in several respects. At first, the micromorphology is very similar, particularly the strongly encrusted cystidia which sometimes have a prolonged hyphal part (pseudocystidia). Also the shape and size of the basidia and spores indicate a close relationship to Steccherinum. Moreover, Phlebia, where it has been placed by Christiansen (1960), is known to contain species which are bipolar and with a astatocoenocytic nuclear behaviour whereas Odontia queletii is proved to be tetrapolar and with a normal nuclear behaviour (Boidin & Lanquetin, 1984). The latter character is shared with species of Steccherinum.

STECCHERINUM ALBO-FIBRILLOSUM (Hjortst. & Ryv.) Hallenb. & Hjortst. comb. nov. Basionym: Phlebia albo-fibrillosa Hjortst. & Ryv., Mycotaxon 20:139, 1984.

This species is similar to S. queletii, but may be readily distinguished by shorter and more subglobose spores that are 4-4.5(-5) x 3.5-4 µm (in S. queletii 5-6 x 3-3.5 µm) and a whiter fruitbody with fibrous margin.

ACKNOWLEDGEMENTS. We are indebted to D. Pegler, London, for his critical review and for correcting the English, to E. Hansson, Göteborg for making the photos.

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Christiansen, M.P. 1960: Danish Resupinate Fungi. Part II. Dansk Bot. Ark. 19(2): 57-388.
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SPECIES DELIMITATION IN CORTICIACEAE (BASIDIOMYCETES)

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Abstract. Compatibility tests were used to study species delimitation in 25 species of Corticiaceae. Interincompatible siblings were detected in seven species. An additional incompatibility system, restricting dikaryotization between homokaryotic mycelia were found in Peniophora limitata and Bulbillomyces farinosus.

Introduction. The study of basidiocarp morphology has been the basis for taxonomic species delimitation in Corticiaceae. In heterothallic species, compatibility tests have been used as an additional method to find out the limits between closely related species. Basidiocarps from which compatible cultures originate, have been compared with each other and with the actual taxonomic definition of the species concerned. In this way it is possible to give a more precise description of the morphological variation as well as ecological amplitude and geographical distribution. This is also one of the main purposes with this paper.

In Boidin (1977) and Hallenberg (1984) a number of earlier records from compatibility studies are summarized. Later results are given in publications by Boidin and Lanquetin, Ginns, Hallenberg, and others.

Culture data exist now for a great number of species. However, our knowledge from compatibility studies, on species variation, habitat preference and distribution is still fragmentary. Moreover, an increasing number of sibling species have been detected as a result of such tests. These siblings are very similar or apparently identical in their basidiocarp morphology but constitute genetically isolated groups (biological species). In this paper, sibling species are reported from seven taxonomical species.
As shown below, separating characters between different siblings seem to be their preferences for different substrates or habitats. This has also been indicated in earlier reports (Hallenberg 1986 a, b). A hypothesis is discussed in Hallenberg (1987), on differences in substrate or habitat preference as possible first steps in speciation processes for some species in Corticiaceae.

Intercompatibility has been accepted as a condition for "biological" conspecificity. Nevertheless, there are several explanations to negative results in mating tests between specimens which belong to the same biological species (see Boidin, 1986). From the results presented below there exist factors which restrict the mating ability in Peniophora limitata and Bulbillomyces farinosus, and which are additional to mating type system.

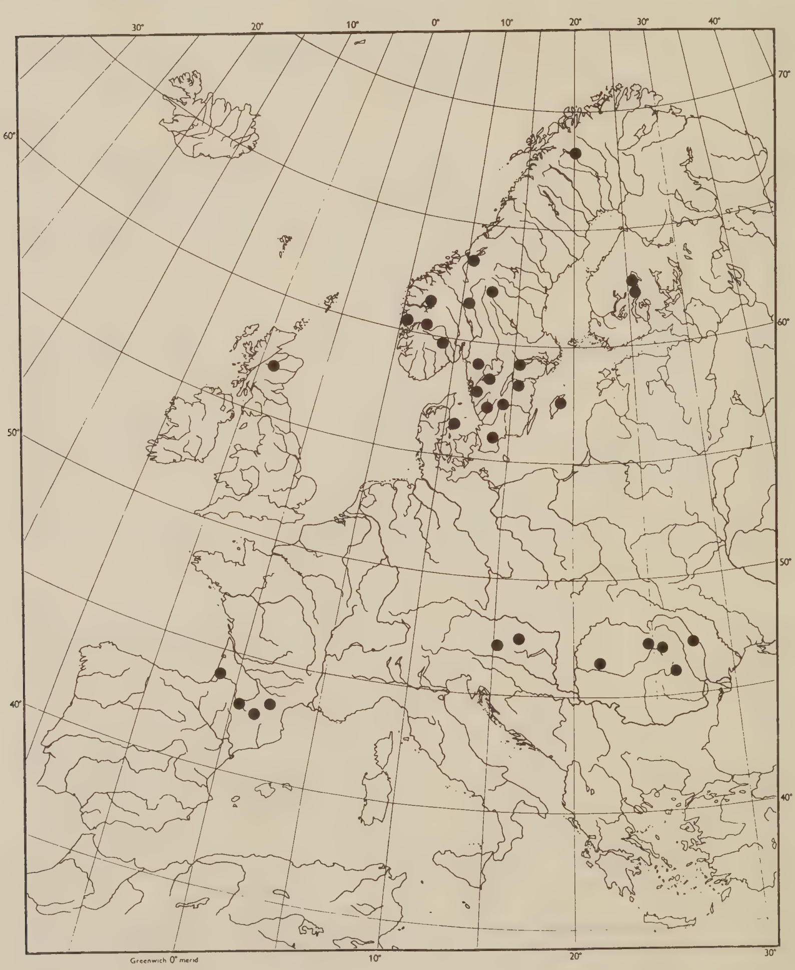
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Fig. 1. Collecting localities in Europe, from where the investigated specimens originate.

METHODS. The specimens originate in Austria, Canada, Denmark, Finland, France, Norway, Romania, Scotland, Spain, and Sweden. Main collecting localities are marked in fig. 1. The studied specimens have been carefully compared with types or other representative material. When spore measurements are given these have been made from spore prints. Single-spore (SS)-cultures and polyspore (PS-)cultures were isolated after dispersal on common malt agar. To determine the breeding ability (i.e., the ability to form clamps in matings) of the individual SS-cultures, matings between SS-cultures of each specimen were first made. Compatible mating types from one specimen were mated with compatible mating types from the other specimens. In some cultures it was impossible to obtain compatible mating types. However, such SS-cultures have been accepted if they were compatible in matings with cultures from other specimens. Formation of clamps in matings was looked for after that the mycelia had been in contact for 6 weeks.
Doubtful and unexpected results were repeated. To check the occurrence of dikaryons in some cases, mycelia from the confrontation line were subcultured in malt liquid and stained in giemsa (staining method according to Boidin, 1958).

In the lists of "material" (below, under each species) information concerning the studied specimens are given. Such data are cathegorized by slanted lines: Culture number/ substrate/ locality/ SS-numbers of compatible mating types, separated by a slant line ("/"). When no compatible mating types have been found, the total number of available cultures is given.

Cultures are stored in the culture-collection at the Department of Systematic Botany, Gothenburg University. The GB-numbers refer to the culture-collection. The original specimen together with spore-print can be identified by the same number and are kept in the herbarium (GB). Descriptions of basidiocarps are referred to "Corticiaceae of North Europe" (Eriksson and Ryvarden, Eriksson et al, 1973-1987).

RESULTS

Athelia decipiens (Höhn & Litsch.)John Erikss.

Material:
GB 0291/ Picea/ Sweden, Småland/ 1,2,5/4,6,7,8,9,10.
GB 0388/ Castanea/ Austria, Steiermark/ 1/2.
GB 1494/ coniferous wood/ Romania, Suceava/ 2,4,7/3,5,6,8.
GB 1687/ Picea/ Finland, South Häme/ 1,5,7,9/2,3,6,8,10.
GB 1691/ Picea/ Finland, North Häme/ 3,8/1,2,4,5,6,7,9.
GB 1762/ Acer/ Sweden, Dalsland/ 1,4,8,9/2,5,7,6,10.

All the above mentioned cultures are intercompatible. No morphological differences between the basidiocarps have been noticed.

	GB 932-1	GB 932-2	GB 932-3	GB 932-4	GB 932-5	GB 932-6	GB 1033-1	GB 1033-2	GB 1033-3	GB 1033-5	GB 1034-1	GB 1034-3	GB 1034-5	GB 1034-2	GB 1034-4	GB 1270-1	GB 1270-3	GB 1270-4	GB 1270-2	GB 1270-5	GB 1510-1	GB 1510-3	GB 1510-2	GB 1510-4	GB 1510-6	GB 1510-8
GB 1033-1																					–		+[1]	+[2]	–	
GB 1033-2	+	+									+	+		–		–	–		+	+						
GB 1033-3	+	+									+	+		+		–	–		+	+						
GB 1033-5																					–		–	–	–	
GB 1034-1	+	+						+	+							+			+		+		+	+	+	
GB 1034-3	+	+						+	+							+			+		+		+	+	+	
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GB 1270-1	+	+	+	+				–	–		+	+		+							+		+	+	+	
GB 1270-3	+	+	–	–				–	–																	
GB 1270-4																										
GB 1270-2	–	–						+	+		+	+		+							–[4]		–	–[4]	–	
GB 1270-5	–	–						+	+																	
GB 1510-1	–	+	–	–			–			–	+	+				+			–[4]							
GB 1510-3																										
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GB 1510-4	–	+	–	–			+[2]			–	+	+				+			–[4]							
GB 1510-6	–	+	–	–			–			–	+	+				+			–							
GB 1510-8																										
GB 1529-1	+	+						–	+		–	+				+	+				–		+	–	+	
GB 1529-2	+	+						–	–		+	+				+	+				+		+	+	+	
GB 1529-3											–	+									–			–		

	GB 1529-1	GB 1529-2	GB 1529-3	GB 1726-1	GB 1726-2	GB 1726-3	GB 1726-4	GB 1726-5	GB 1726-6	GB 1758-1	GB 1758-3	GB 1758-8	GB 1760-1	GB 1760-2	GB 1760-3	GB 1830-5	GB 1830-7	GB 1830-8
GB 1033-1																		
GB 1033-2	–	–																
GB 1033-3	+	–		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GB 1033-5																		
GB 1034-1	–	+	–	+	–	–	–	+	+	+	–		+	+	+	+	+	+
GB 1034-3	+	+	+	–	+	+	–	+	+	+	+		+	+	+	+	+	+
GB 1034-5				–	+	+	–	+	+	+	–		+	+	+	+	+	+
GB 1034-2				–	–	–	–	+	+	+	+		+	+	+	+	+	+
GB 1034-4				–	–	–	–	+	+	+	–		+	+	+	+	+	+
GB 1270-1	+	+		–	–	–	–	–	–	–	–	–	–	–	–	+	+	+
GB 1270-3	+	+		+[3]	–	+[3]	+[3]	–	–	–	–	–	+	+	+	+	+	+
GB 1270-4				–	–	–	–	–	–	–	–	–	–	–	–			
GB 1270-2				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GB 1270-5																+	+	+
GB 1510-1	–	+	–	–	–	–	–	–	–	–	–	–	–	+	+	+	+	+
GB 1510-3				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GB 1510-2	+	+		–	–	–	–	–	–	–	–	+	–	+	+	+	+	+
GB 1510-4	–	+	–	–	+	–	–	–	–	–	–	+	–	+	+	+	+	+
GB 1510-6	+	+		+	–	–	–	+	–	–	–	+	+	+	+	+	+	+
GB 1510-8				–	–	–	–	–	–	–	–	–	+	+	+	+	+	+
GB 1529-1				+	–	–	+	–	–	–	–	+	+	+	+	+	+	+
GB 1529-2				+	–	–	+	–	–	–	–	+	+	+	+	+	+	+
GB 1529-3				+	–	–	+	–	–	–	–	+	+	+	+	+	+	+

	GB 932-1	GB 932-2	GB 932-3	GB 932-4	GB 932-5	GB 932-6	GB 1033-1	GB 1033-2	GB 1033-3	GB 1033-5	GB 1034-1	GB 1034-3	GB 1034-5	GB 1034-2	GB 1034-4	GB 1270-1	GB 1270-3	GB 1270-4	GB 1270-2	GB 1270-5	GB 1510-1	GB 1510-3	GB 1510-2	GB 1510-4	GB 1510-6	GB 1510-8	GB 1529-1	GB 1529-2	GB 1529-3	GB 1726-1	GB 1726-2	GB 1726-3	GB 1726-4	GB 1726-5	GB 1726-6	GB 1758-1	GB 1758-3	GB 1758-8	GB 1760-1	GB 1760-2	GB 1760-3	GB 1830-5	GB 1830-7	GB 1830-8
GB 1726-1	+		+	+	+	+			+		+	-	-	-	-	-	$+^3$	-	+		-	+	-	-	+	-	+	+	+							-	-	-	+	+	+	+	+	+
GB 1726-2	+		+	-	-	+			+		-	+	+	-	-	-	-	-	+		-	+	-+		-	-	-	-	-							-	-	-	+	+	+	+	+	+
GB 1726-3	+		+	+	+	+			+		-	+	+	-	-	-	$+^3$	-	+		-	+	-	-	-	-	-	-	-							-	-	-	+	+	+	+	+	+
GB 1726-4	+		+	+	+	+			+		-	-	-	-	-	-	$+^3$	-	+		-	+	-	-	-	-	+	+	+							+	+	-	+	+	+	+	+	+
GB 1726-5	+		+	-	-	+			+		+	+	+	+	+	-	-	-	+		-	+	-	-	+	-	-	-	-							-	-	+	+	+	+	+	+	+
GB 1726-6	+		+	-	-	+			+		+	+	+	+	+	-	-	-	+		-	+	-	-	-	-	-	-	-							-	-	+	+	+	+	+	+	+
GB 1758-1	+		+	+	+	+					+	+	+	+	+	-	-	-	+		-	+	-	-	-	-	-	-	-	-	-	-	+	-	-									
GB 1758-3	+		+	+	+	+					-	+	-	+	-	-	-	-	+		-	+	-	-	-	-	-	-	-	-	-	-	+	-	-									
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GB 1760-1	-		-	-	+	-			+		+	+	+	+	+	-	+	-	+		-	+	-	-	+	+	+	+	+	+	+	+	+	+	+							+	+	+
GB 1760-2	-		-	-	+	+			+		+	+	+	+	+	-	+	-	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							+	+	+
GB 1760-3	-		-	-	+	-			+		+	+	+	+	+	-	+	-	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+							+	+	+
GB 1830-5	-		-	-	-	-			+		+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+				+	+	+			
GB 1830-7	-		-	-	-	-			+		+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+				+	+	+			
GB 1830-8	+		+	+	+	+			+		+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+				+	+	+			

Fig. 2. Crossings in Bulbillomyces farinosus. 1 = negative result on MA dish, constant clamps when subcultured in malt liquid and grown under a collodion film. 2 = as above, but only a few clamps detected when subcultured in malt liquid. 3 = distinct barrier formed between the SS-cultures, only a few clamps formed on confrontation line. 4 = a few false clamps formed on confrontation line.

One character in this species is the lack of clamps in all parts of the basidiocarps. In cultured secondary mycelia, however, clamps are present at many septa (inconstant clamps - Boidin and Lanquetin, 1984 a). Bipolarity is indicated and the nuclear behaviour is normal.

Athelia decipiens is reported to be frequent in the conifer region in N. Europe, occurring in both drier forests and more humid ones (Corticiaceae of North Europe). The investigated specimens were collected on decayed wood and trunks (both white- and brown-rotted) of Picea, Acer, Castanea, both on lignum and on bark.

Basidioradulum radula (Fr.)Nobles

Material:
GB 0246/ Salix/ Sweden, Torne Lappmark/ 2,4/5.
GB 0374/ Abies/ Austria, Steiermark/ 1/2,4.
GB 0381/ Abies/ Austria, Steiermark/ 1,2/3,4,5.
GB 0386/ Prunus/ Austria, Steiermark/ 1/2,3,4.
GB 0463/ Alnus/ Norway, South Tröndelag/ 7 SS.
GB 0582/ Populus/ Canada, Quebec/ 2 SS.
GB 0783/ deciduous wood/ Canada, Quebec/ 1,3/2,4.
GB 1016/ Abies/ Romania, Suceava/ 5 SS.
GB 1706/ Alnus/ Finland, North Häme/ 5 SS.
GB 1805/ Abies/ Spain, Lerida/ 2,3,7,8/4,5,9,10.
GB 1844/ Abies/ Spain, Lerida/ 2 SS.

Complete compatibility between the above mentioned cultures. No morphological differences between the basidiocarps noticed in the microscope, but macroscopically the species is obviously variable. The hymenophore may be almost smooth to raduloid with teeth up to 5 mm long. Recorded on both bark and wood, in N. Europe frequently on deciduous wood, in C. and S. Europe often found on Abies.

Bulbillomyces farinosus (Bres.)Jül.

Material:
GB 0932/ deciduous wood/ Scotland, Perthshire/ 6 SS.
GB 1033/ deciduous wood/ Romania, Iasi/ 2/3,4.
GB 1034/ deciduous wood/ Romania, Suceava/ 1/3,5.
GB 1270/ Fagus/ Sweden, Skåne/ 1,3,4/2,5.
GB 1510/ deciduous wood/ Romania, Iasi/ 2/1,3,5,7; 4/6,8.
GB 1529/ Carpinus/ Romania, Iasi/ 3 SS.
GB 1726/ deciduous wood/ Sweden, Västergötland/ 1/2,3,7; 4/5,6,8,9.
GB 1758/ deciduous wood/ Sweden, Västergötland/ 1,3,6/8.
GB 1760/ deciduous wood/ Sweden, Västergötland/ 5 SS.
GB 1830/ deciduous wood/ Spain, Lerida/ 5/7,8.

No noticeable morphological differences between the basidiocarps have been seen, with the exception for the frequency of encrusted cystidia, which is variable. Moreover, the size of the basidiocarp varies. Mostly they are very small and the specimens are recognized in the field because of abundant Aegerita-state. However, sometimes the basidiocarps are bigger (GB 1760) and in Lundell & Nannfeldt (1953) a specimen is reported where the basidiocarp covers several dm^3. The latter specimen, as well as GB 1760 were compatible with other specimens with small basidiocarps.

The compatibility tests performed here gave a number of unexpected results (fig. 2). In some matings a narrow but distinct barrier was formed and no clamps or dikaryons were recorded. This incompatibility is not of homogenic nature (identical mating type alleles) because different SS-cultures, representing the same mating type in a specimen, behaved differently in matings with certain other cultures. The same kind of behaviour was reported by Boidin and Lanquetin (1984 c) in matings between Amylostereum ferreum (Berk. & Curt.)Boid. & Lanq. and A. laevigatum (Fr.)Boid. In two matings, however, no clamps were formed in matings on the malt agar dish (GB 1033/1 x GB 1510/2 and 4). After the confrontation line had been subcultured in malt liquid and then grown under a collodion film on a slide, constant clamps were seen. However, this change of behaviour was not found in other "negative" matings.

This incompatibility seems to be of heterogenic nature and the responsible genes are not linked to the mating type system, but superimposed on it. The genetical structure of this incompatibility system is not further analyzed here, however, the biological consequences must be that an additional mating barrier exist.

Ceraceomerulius serpens (Fr.)Erikss. & Ryv.

Material:
GB 262/ Salix/ Sweden, Torne Lappmark/ 1 SS, 1 PS.
GB 536/ Picea/ Canada, Quebec/ 1/2; 3/4.
GB 816/ Fagus/ Canada, Quebec/ 1 PS.
GB 915/ Juniperus/ Norway, North Tröndelag/ 1 haploid SS used; 8 other isolated SS were clamped.
GB 1452/ Fagus/ Sweden, Västergötland/ 1,3,4/5,8; 2,6/7.
GB 1731/ Corylus/ Sweden, Västergötland/ 2/6.
LY 10020/ Picea/ Austria, Nieder Österreich/ 2 SS.

GB 1209/ Populus/ Norway, Telemark/ 1/2,3,4.
GB 1246/ deciduous wood/ Norway, Opland/ 1,2/3.

GB 1711/ Pinus/ Finland, North Häme/ 1,7/2,5,6; 3/4,8.
GB 1811/ Pinus/ Spain, Huesca/ 1/3.

C. serpens has been regarded as a species with rather variable macroscopic basidiocarp features, but morphologically uniform in the microscope. Further, it is a widely distributed species over the N. hemisphere and it has a wide substrate spectrum. The hymenium may be smooth in very young specimens and in distal parts of the basidiocarps, or distinctly meruloid in well developed basidiocarps. Its margin varies from rather narrow to wide and byssoid, frequently whitish. Rhizomorphic strands may be present or absent in association to the basidiocarp. The colour is frequently greyish ochraceous but with reddish, greenish, or yellowish tints. C. serpens has been reported from a number of deciduous and coniferous trees. The basidiocarps have been found in association with booth white- and brown-rotted wood.

	GB 536-1	GB 536-2	GB 536-3	GB 536-4	GB 816-PS	GB 915-7	LY 10020-1	LY 10020-2	GB 1452-1	GB 1452-5	GB 1452-2	GB 1452-7	GB 1731-1	GB 1731-2	GB 1731-3	GB 1209-1	GB 1209-2	GB 1209-3	GB 1246-1	GB 1246-2	GB 1246-3	GB 1711-1	GB 1711-2	GB 1711-3	GB 1711-4	GB 1811-1	GB 1811-3
GB 262-1	+	+	+	+			+	+	+		+					–	–		–								
GB 262-PS	+	+																									
GB 536-1					–											–	–		–		–						
GB 536-2					+		+	+								–	–		–		–						
GB 536-3							+	+					+	$-^{1}$					–		–	–	–	–	–	–	–
GB 536-4													+	+					–		–	–	–	–	–	–	–
GB 816-PS	–	+														–	–										
GB 915-7									+	+						–	–			–	–						
LY 10020-1		+	+						+		+					–	–					$-^{3}$	$-^{3}$				
LY 10020-2		+	+						+		+					–	–					$-^{3}$	$-^{3}$				
GB 1452-1						+	+	+					+	+		–	–			–	–	$-^{3}$	$-^{3}$	–	–	–	–
GB 1452-5						+							+	+								$-^{3}$	$-^{3}$	–	–	–	–
GB 1452-2							+	+					+	+		–	–			–	–	–	–	–	–	–	–
GB 1452-7													+	+								–	–	–	–	–	–
GB 1731-1			+	+					+	+	+	+				–	–		–		–	–	–	–	–	–	–
GB 1731-2			$-^{1}$	+					+	+	+	+				–	–		–		–					–	–
GB 1731-3																						–	–	–	–		
GB 1209-1	–	–			–	–	–	–	–		–		–	–					+		+	$-^{2}$	$-^{2}$	–	–	–	–
GB 1209-2	–	–			–	–	–	–	–		–		–	–					+		+	$-^{2}$	$-^{2}$	–	–	–	–
GB 1209-3																						–	–	–	–		
GB 1246-1	–	–	–	–									–	–		+	+					–	–	–	–	–	–
GB 1246-2						–			–		–													–	–		
GB 1246-3	–	–	–	–		–			–		–		–	–		+	+					–	–	–	–	–	–
GB 1711-1			–	–			$-^{3}$	$-^{3}$	$-^{3}$	$-^{3}$	–	–	–		–	$-^{2}$	$-^{2}$	–	–		–					+	+
GB 1711-2			–	–			$-^{3}$	$-^{3}$	$-^{3}$	$-^{3}$	–	–	–		–	$-^{2}$	$-^{2}$	–	–		–					+	+
GB 1711-3			–	–					–	–	–	–	–		–	–	–	–	–	–	–					+	+
GB 1711-4			–	–					–	–	–	–	–		–	–	–	–	–	–	–					+	+
GB 1811-1			–	–					–	–	–	–	–	–		–	–		–		–	+	+	+	+		
GB 1811-3			–	–					–	–	–	–	–	–		–	–		–		–	+	+	+	+		

Fig. 3. Confrontations in Ceraceomerulius serpens. 1 = Distinct barrier between the two mycelia. GB 536-3 forms lots of cordons. 2 = A weak, but distinct barrier formed. 3 = A strong barrier formed, which is reddish brown.

From intercompatibility tests follows that three incompatibility groups have been distinguished (fig. 3):
Group 1: GB 262, GB 536, GB 915, GB 1452, GB 1731, LY 10020.
Group 2: GB 1209, GB 1246.
Group 3: 1711, GB 1811.
Group 1. These specimens have been found on a variety of deciduous trees and on Picea, Juniperus (and Pinus in Canada). They are associated with rather hard or distinctly brown-rotted wood. Tetrapolarity is indicated.

Group 2. These specimens were collected in S. Norway on deciduous wood (Alnus and Populus) in mixed forests. The basidiocarps were associated with loose, white-rotted wood. Bipolarity is indicated but only few SS-cultures available.

Group 3. These specimens were collected on Pinus in old virgin forests with mixed coniferous and deciduous trees. The basidiocarps were associated with rather hard wood. Tetrapolarity is indicated. Both specimens had a greenish tint but in other respects the basidiocarp morphology was in accordance with group 1 and 2. In our herbarium (GB) there are several findings of C. serpens on Pinus and most of them have a greenish tint.

Drop tests for extracellular oxidases were negative for all three groups (Syringaldazine, 1-Naphthol, Gum Guaiac, Guaiacol, p-Cresol, L-Tyrosine - Marr, 1979).

The polarity pattern for C. serpens has been differently interpreted. According to Ginns (1976) it is bipolar, while Boidin and Lanquetin (1984 b) report tetrapolarity. The existence of three (or more) siblings within this complex may explain the different results.

Cystostereum murraii (Berk. & Curt.)Pouz.

Material:
GB 0129/ Picea/ Sweden, Dalarna/ 2,3/4.
GB 0588/ Acer/ Canada, Quebec/ 1,2/4.
GB 0738/ Betula/ Canada, Ontario/ 2 SS.
GB 1051/ Abies/ Romania, Suceava/ 5 SS.
GB 1826/ Abies/ Spain, Huesca/ 5 SS.

All investigated specimens are fully intercompatible. Eriksson & Ryvarden (1975) noticed that there are some differences in basidiocarp morphology and substrate preference between European and N. American specimens. Kotlaba (1987) reports that C. murraii is widely distributed over the earth and that the species in Europe has been found on both Picea and Abies, rarely also on deciduous trees. Hallenberg (1984) reported compatibility between the above mentioned cultures from Canada and GB 129 (on Picea). Now, two specimens on Abies from S. Europe have been added to this compatibility group.

Gloeocystidiellum clavuligerum(Höhn. & Litsch.)Nakas.

Material:
GB 0554/ deciduous wood/ Canada, Quebec/ 1/2.
GB 0656/ Pseudotsuga/ Canada, B.C./ 4 SS.
GB 0670/ Alnus/ Canada, B.C./ 1,3/4.
GB 0676/ Alnus/ Canada, B.C./ 1,3/4.
GB 0677/ Alnus/ Canada, B.C./ neohaploidized PS-culture used in mating tests.
GB 1039/ deciduous wood/ Romania, Bihor/ 5 SS.

Intercompatibility between the N. American specimens (above) have earlier been verified (Hallenberg, 1984). There, I argued that the type collection was not conspecific with the N. American material used in my tests. A repeated study of the type collection showed that one piece of it contained a small basidiocarp which was in accordance with the N. American specimens used by me as well as those used by Nakasone (1982). In 1983 I collected a specimen of G. clavuligerum from Romania which proved to be compatible with those of N. America.

Gloeocystidiellum porosum (Berk. & Curt.)Donk

Material:
GB 0038/ Ulmus/ Sweden, Västergötland/ 3 SS.
GB 0061/ Fagus/ Denmark, Jutland/ 1,6,8/5,10; 3,4/7,9.
GB 0072/ Fraxinus/ Denmark, Jutland/ 3/5.
GB 0324/ Ulmus/ Sweden, Närke/ 3 SS.
GB 0587/ Alnus/ Canada, Quebec/ 1/2.
GB 0690/ Alnus/ Canada, B.C./ 2/3.
GB 0898/ deciduous wood/ Denmark, Jutland/ 5 SS.
GB 0937/ Ulmus/ Sweden, Västergötland/ 9 SS.
GB 1018/ Fagus/ Romania, Suceava/ 5 SS.
GB 1168/ Corylus/ Sweden, Bohuslän/ 5 SS.
GB 1183/ Alnus/ Norway, Sogn and Fjordane/ 5 SS.
GB 1184/ Alnus/ Norway, Sogn and Fjordane/ 5 SS.
GB 1271/ Quercus/ Sweden, Skåne/ 5 SS.

The incompatibility group from Hallenberg (1984) has been enlarged with 5 additional specimens. No morphological differences between the basidiocarps and fully intercompatibility recorded.

Hyphodontia alutacea (Fr.)John Erikss.

Material:
GB 0328/ Ulmus/ Sweden, Närke/ 1,2/3.
GB 0405/ deciduous wood/ Austria, Steiermark/ 4/3,5.
GB 1683/ Picea/ Sweden, Halland/ 1,2/3,4,5,6.

GB 1721/ Pinus/ Sweden, Småland/ 1,4,5,7,8,10/2,3,6,9.

Complete intercompatibility between GB 328, GB 405, and GB 1683. GB 1721 was incompatible with the other cultures.

According to Eriksson & Ryvarden (1976), H. alutacea occurs on decayed coniferous wood, and almost all herbarium material available in GB has been collected on such substrates.
The basidiocarp morphology in 1721 is very similar to the other specimens macroscopically. However, in the microscope there are some minor differences: In the main group the hyphae in the centre of the aculei are more thick-walled, contrasting rather distictly to the slightly more thin-walled subhymenial hyphae. In GB 1721 there is no distinct differentiation between the central hyphae and the subhymenial ones.

Hyphodontia alutaria (Burt)John Erikss.

Material:
GB 0181/ Picea/ Sweden, Östergötland/ 3 SS.
GB 0207/ deciduous wood/ Sweden, Västergötland/ 1/6; 2/5.
GB 1339/ Juniperus/ Sweden, Gotland/ 1,3,6/2,4,5.
GB 1558/ Picea/ Romania, Suceava/ neohaploidized PS-culture used in mating tests.
GB 1836/ Abies/ Spain, Huesca/ 1,3/2,4,5.

Complete compatibility between investigated specimens. The specimens are very similar in basidiocarp morphology, differing only slightly in the size of projecting cystidia.

Hyphodontia arguta (Fr.)John Erikss.

Material:
GB 0062/ Fagus/ Denmark, Jutland/ 8 SS.
GB 0344/ deciduous wood/ Sweden, Västmanland/ 1/3,4.
GB 0798/ deciduous wood/ Canada, B.C./ 4 SS.
GB 1083/ Picea/ Romania, Suceava/ 1 PS.
GB 1298/ Ulmus/ Sweden, Skåne/ 6/2,3,4,5.
GB 1347/ Ulmus/ Sweden, Västergötland/ 6 SS.
GB 1355/ Ulmus/ Sweden, Västergötland/ 6 SS.
GB 1541/ Fagus/ Austria, Steiermark/ 1,2,3,5,7/4,6.

Complete compatibility between the specimens above. No morphological differences between the basidiocarps, with exception for the length of the aculei (0,5 - 1,5 mm).

Hyphodontia aspera (Fr.)John Erikss.

Material:
GB 1093/ Picea/ Romania, Suceava/ 1,6,9/8,13; 4,5,10/12.
GB 1094/ Picea/ Romania, Alba/ 2/4,5.
GB 1278/ Picea/ Norway, Opland/ 1/2.
GB 1313/ Picea/ Norway, Opland/ 3 SS.
GB 1333/ Populus/ Norway, Opland/ 4 SS.
GB 1409/ Juniperus/ France, Savoie/ 2 SS.
GB 1543/ Alnus/ Austria, Steiermark/ 2,3/6.
GB 1562/ Picea/ Romania, Suceava/ 1 PS.

In Hallenberg (1984) a number of interincompatible specimens were reported from Hyphodontia aspera-breviseta complex. Two Romanian cultures (GB 1093 and GB 1094) were then found to be compatible and this group has now been enlarged to 8 specimens (above). These specimens are fully interincompatible and very uniform in their basidiocarp morphology.

Fructification starts with a white, cottony mycelium covering the substrate surface and later a smooth, continuous hymenium with scattered aculei appears. Then it is no longer pure white but has a light creamish tint. The aculei in mature basidiocarps are scattered and there is always continuous hymenium in between. The aculei are initially small and conical but will soon be longer and with penicillate apices. The context in basidiocarps is rather loose.

This description is clearly embraced by the taxonomic definition for H. aspera given in Eriksson & Ryvarden (1976). However, there is no doubt that this definition covers several sibling species, which in basidiocarp morphology are very similar. A few are mentioned under H. aspera in Hallenberg (1984). An additional incompatible specimen has been found in Norway (GB 1309), differing minutely in micromorphology (more dense tissue, more frequent capitate cystidioles).

Hyphodontia crustosa (Fr.)John Erikss.

Material:
GB 1163/ deciduous wood/ Sweden, Bohuslän/ 4 SS.
GB 1345/ Corylus/ Sweden, Gotland/ 2,3/4.
GB 1364/ Juniperus/ Sweden, Gotland/ 1,3,4,6/5.
GB 1548/ Picea/ Romania, Brasov/ 1,8/4; 9/5,7.
GB 1559/ Fagus/ Romania, Suceava/ 1 PS.
GB 1824/ deciduous wood/ Spain, Lerida/ 1/2.
LY 3614/ coniferous wood/ France, Tarn/ 1/2.

GB 1779/ deciduous wood/ Finland, South Häme/ 5 SS.

Intercompatibility between above mentioned cultures, except for GB 1779. The specimens in the main group are very similar in their basidiocarp morphology, while GB 1779 deviates by minutely longer and narrower spores.

Hyphodontia pallidula (Bres.)John Erikss.

Material:
GB 0802/ coniferous wood/ Canada, B.C./ 3 SS.
GB 1296/ Picea/ Sweden, Halland/ 1,3,6/2,4,7.
GB 1365/ Fagus/ Sweden, Dalsland/ 1/5.

Many attempts have been made to get SS-cultures from spore prints of this species, without success. Gradually, however, a few cultures have been obtained which have been shown to be fully compatible. No morphological differences between their basidiocarps noticed.

Hyphodontia pruni (Lasch)Svrcek

Material:
GB 0346/ Corylus/ Sweden, Närke/ 1/4; 2/3.
GB 0829/ Ulmus/ Sweden, Västergötland/ 3/4.
GB 1343/ deciduous wood/ Sweden, Västergötland/ 2,3/4.
GB 1346/ Fraxinus/ Sweden, Gotland/ 1,3,5/2.
GB 1348/ Corylus/ Sweden, Gotland/ 1/5.

Intercompatibility between the cultures above. No morphological differences between the basidiocarps noticed.

Hyphodontia rimosissima (Peck)Gilb.

Material:
GB 0085/ Fraxinus/ Denmark, Jutland/ 1,3/2.
GB 0273/ Fraxinus/ Denmark, Jutland/ 1 PS.
GB 0345/ deciduous wood/ Sweden, Västergötland/ 1 PS.
GB 1228/ Fagus/ Norway, Rogaland/ 2 SS.
GB 1301/ Acer/ Sweden, Skåne/ 1,3,4/2,5.
GB 1314/ Fagus/ Sweden, Skåne/ 3 SS.
GB 1460/ Ulmus/ Sweden, Västergötland/ 6 SS.

These specimens were fully intercompatible and no morphological differences between the basidiocarps were seen. All specimens were collected on white-rotted wood. In Hallenberg (1984) it was shown that specimens from Europe were partially compatible with specimens from N. America.

Hyphodontia subalutacea (Karst.)John Erikss.

Material:
GB 0096/ Pinus/ Sweden, Dalarna/ 6 SS.
GB 0286/ Pinus/ Denmark, Jutland/ 4 SS.
GB 1433/ coniferous wood/ Norway, Oslo/ 1/5,7.

GB 0299/ Quercus/ Sweden, Småland/ 5 SS.
GB 0335/ Ulmus/ Sweden, Närke/ 1 SS, 1 PS.
GB 0349/ Quercus/ Sweden, Västmanland/ 3 SS.
GB 1095/ deciduous wood/ Sweden, Västergötland/ 5 SS.
GB 1205/ Fagus/ Norway, Rogaland/ 1,3,5/2,4.
GB 1208/ Betula/ Norway, Hordaland/ 2/5.
GB 1522/ Fagus/ Romania, Brasov/ 1/3.

GB 0961/ Betula/ Scotland, Perthshire/ 7 SS.

GB 1318/ Pinus/ Sweden, Gotland/ 1/6.

GB 1834/ Pinus/ France, Pyrenees Orientales/ 1,3/5; 2/4.

GB 1838/ Pinus/ Spain, Huesca/ 2/3.

Incompatibility has been shown between the following groups and specimens. Within each group fully intercompatibility has been recorded.

Group 1. GB 96, GB 286, GB 1433. This group seems to be confined to coniferous wood in Europe.

Group 2. GB 299, GB 335, GB 349, GB 1095, GB 1205, GB 1208, GB 1522. The specimens in this group were all collected on wood from deciduous trees.

Group 3. GB 961. This specimens deviates from the other groups morphologically by an almost smooth and continuous hymenium. Moreover, the basidiocarp was associated with strongly decayed, white-rotted wood, while all other groups in H. subalutacea were associated with rather hard wood when dried, frequently with a typical brown-rot.

Group 4. GB 1318. The basidiocarp of this specimen is more adnate than other representatives, and more ceraceous in its consistency.

Group 5. GB 1834. The basidiocarp is cream-coloured and rather thick.

Group 6. GB 1838. The basidiocarp is thin and whitish.

Two specimens from Canada also belong to group 1, but one of these was also compatible with representatives of group 2 (Hallenberg, 1984).
With exception of the differences mentioned above, the tested specimens are very similar in basidiocarp morphology. Even if some species in the close vicinity of H. subalutacea have been described (H. altaica Parm, H. cineracea (Bourd. & Galz.)Erikss. & Hjortst., H. floccosa (Bourd & Galz.)John Erikss.) it seems obvious that some more (biological) species exist in this complex.

Hypochnicium eichleri (Bres.)Erikss. & Ryv.

Material:
GB 0936/ Picea/ Scotland, Perthshire/ 2 SS.
GB 0938/ Betula/ Scotland, Perthshire/ 3 SS.
GB 1065/ Betula/ Romania, Suceava/ 6 SS.
GB 1203/ Alnus/ Norway, Hordaland/ 2 SS.
GB 1362/ Fagus/ Sweden, Dalsland/ 2/1,3.
GB 1794/ Pinus/ France, Landes/ 1,3,5,6/4,9,10; 2,8/7.

GB 1772/ Pinus/ Sweden, Dalsland/ 1,5,6/2,3,7,8.
GB 1865/ Pinus/ Spain, Lerida/ 1/2.

GB 1709/ Pinus/ Finland, South Häme/ 3 SS.

The Hypochnicium eichleri complex was discussed in Hallenberg (1985). The compatibility group detected there (H. eichleri s.str.) has now been enlargened with one more specimen (GB 1794). Still, however, 20 % of the matings within this group are negative. Moreover, three other specimens have been shown to be completely incompatible with the main group (fig. 4):

- GB 1709. This specimen is incompatible with all other avialable cultures in this complex.
- GB 1772 is partial compatible with GB 1865, both of them are incompatible with all other representatives in this complex.

All specimens tested here are very similar in their basidiocarp morphology with exception for GB 1865, where the spores are more ellipsoid - ovoid, and slightly larger than in H. eichleri (8,5-9 x 6-6,5 µm versus 7-8 x 5,5-7 µm). GB 1865 is thus morphologically very close to H. albostramineum (Bres.)Hallenb., while the spores in GB 1772 are slightly smaller and more rounded (7,5-8 x 6,5 µm), and consequently will be placed within the limits for H. eichleri. The spore ornamentation is very similar for all representatives (see fig. 5).

Chlamydospores have been found in culture in the main compatibility group but are absent in the other siblings.

	GB 938-1	GB 938-3	GB 1065-1	GB 1065-2	GB 1203-1	GB 1203-2	GB 1203-5	GB 1203-3	GB 1203-4	GB 1362-1	GB 1362-2	GB 1362-3	GB 1794-1	GB 1794-4	GB 1794-2	GB 1794-7	GB 1709-1	GB 1772-1	GB 1772-2	GB 1772-3	GB 1772-9	GB 1865-1	GB 1865-2
GB 936-1	–	+	+	+						+	+	+	+	+	+	+	–	–		–		–	–
GB 936-3	–	+	+	+						+	+	+	+	+	+	+	–	–		–		–	–
GB 938-1			–	–	–	–		–		+	+	+						–		–			
GB 938-3			+	+		+	+			+	+	+						–		–			
GB 1065-1	–	+			+	+		+		–	+	–[1]	+	+	+	+	–	–		–			
GB 1065-2	–	+			+	+		+		–	+	+	+	+	+	+	–	–		–			
GB 1203-1	–		+	+						+	+	+											
GB 1203-2	–	+	+	+						+	+	+											
GB 1203-5		+								+	+	+											
GB 1203-3	–		+	+						+	+	+					–						
GB 1203-4																	–						
GB 1362-1	+	+	–	–	+	+	+	+					+	+	+	+	–	–		–		–	–
GB 1362-2	+	+	+	+[1]	+	+	+	+					–	–	–	–	–	–		–		–	–
GB 1362-3	+	+	–	+	+	+	+	+															
GB 1794-1			+	+						+	–						–	–		–			
GB 1794-4			+	+						+	–						–	–		–			
GB 1794-2			+	+						+	–						–	–		–			
GB 1794-7			+	+						+	–						–	–		–			
GB 1709-1			–	–				–	–	–	–		–	–	–	–		–		–		–	–
GB 1772-1	–	–	–	–						–	–		–	–	–	–	–					–	–
GB 1772-2																						–	–
GB 1772-3	–	–	–	–						–	–		–	–	–	–	–						
GB 1772-9																						+	+
GB 1865-1										–	–		–	–	–	–	–	–	–		+		
GB 1865-2										–	–		–	–	–	–	–	–	–		+		

Fig. 4. Confrontations in Hypochnicium eichleri. 1 = Only a few clamps formed on confrontation line.

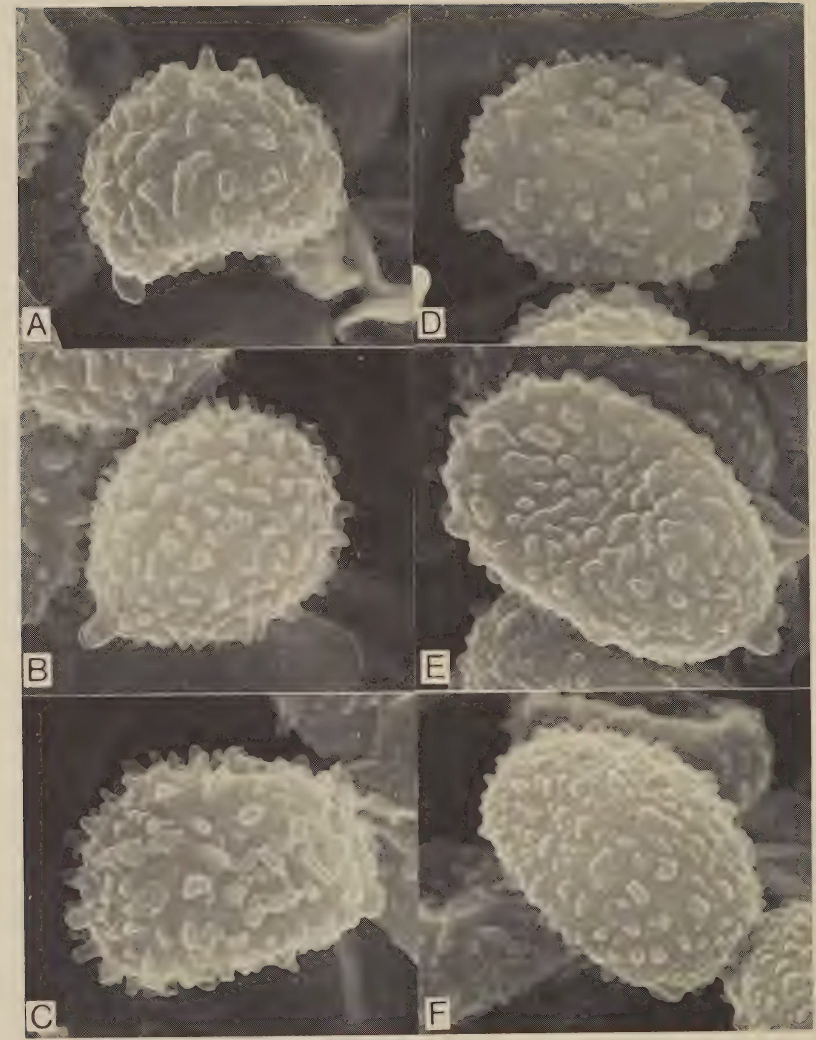

Fig. 5. SEM pictures of spores in Hypochnicium eichleri. A) GB 938, B) GB 1794, C) GB 1203, D) GB 1772, E) GB 1865, F) GB 1709. Magnification: 1 µm = 9 mm. - Photo T. Bergquist.

Leptosporomyces galzinii (Bourd.)Jül.

Material:
GB 0255/ Pinus/ Denmark, Jutland/ 2,4,5/1,3,6,7,8,9.
GB 0270/ Pinus/ Sweden, Torne Lappmark/ 1,5/4,7.
GB 0276/ Picea/ Denmark, Jutland/ 3 SS.

Compatibility between these three specimens. No morphological differences recorded.

Merulius tremellosus Fr.

Material:
GB 0519/ Fraxinus/ Sweden, Västergötland/ 1,3,6,7,8,9/2,4,5.
GB 0617/ Betula/ Canada, Ontario/ 1 PS.
GB 1261/ Fagus/ Sweden, Skåne/ 4 SS.
GB 1447/ Fagus/ Sweden, Västergötland/ 2,5/3.
GB 1787/ Quercus/ France, Les Landes/ 1,4,6,7,10/2,3,5,8,9.
GB 1813/ Betula/ France Pyrenees Orientales/ 1,2/3.

Complete compatibility between the tested specimens. No morphological differences between the basidiocarps noticed.

Peniophora incarnata (Fr.)Karst.

Material:
GB 0043/ Quercus/ Sweden, Skåne/ 1/7; 3/9.
GB 0712/ Alnus/ Canada, B.C./ 2/3.
GB 0728/ Alnus/ Canada, B.C./ 2 SS.
GB 0924/ coniferous wood/ Scotland, Perthshire/ 1/2.
GB 1020/ deciduous wood/ Romania, Iasi/ 5 SS.
GB 1174/ deciduous wood/ Sweden, Bohuslän/ 5 SS.
GB 1502/ deciduous wood/ Romania, Brasov/ 1,2,7/5,6.
GB 1689/ Populus/ Finland, North Häme/ 6,7,9/1,2,3,4,5,8.
GB 1837/ deciduous wood/ Spain, Lerida/ 3 SS.

Complete compatibility between these specimens. There is a small variation in basidiocarp colour between the tested specimens. Normally, the colour is reddish but it may also be slightly brownish (GB 712, GB 1502) or whitish with only a reddish or brownish tint (GB 1689). The sulfocystidia are numerous in all specimens while the number of metuloids varies. In no other respects have any morphological differences been recorded between the specimens.

Peniophora limitata (Fr.)Cooke

Material:
GB 0231/ Fraxinus/ Denmark, Jutland/ 2 SS.
GB 1011/ Fraxinus/ Romania, Suceava/ 4 SS.
GB 1012/ Fraxinus/ Romania, Suceava/ 5 SS.
GB 1167/ Fraxinus/ Sweden, Bohuslän/ 1,2,3,4/5.
GB 1481/ Fraxinus/ Romania, Iasi/ 9 SS.

When the first matings were made in this species, very few combinations with clamp formation were recorded. This was astonishing, as P. limitata was regarded as a well defined species with little delimitation problems. Later, mycelium from the confrontation line in all matings were subcultured in malt liquid, then grown under a collodion film on slides and finally stained in Giemsa. This was done in order to check if there were any dikaryons present in spite of the lack of clamps. It was then realized that both clamps and dikaryons were present in abundance (fig. 6).

Initially, when the SS-mycelia were confronted on a malt-agar dish, a strong barrier was developed between the mycelia. This must be a superimposed incompatibility system which is effective when great amounts of mycelia from two compatible SS-cultures meet, but which is not effective when only single hyphae get in contact with each other. After a prolonged growth (more than 2 months) of the confrontation lines on common malt agar dishes, clamps began to appear, but not in all combinations and only at a low frequency.

	GB 231-1	GB 231-2	GB 231-3	GB 1011-1	GB 1011-2	GB 1012-1	GB 1012-2	GB 1167-1	GB 1167-2	GB 1167-5	GB 1481-1	GB 1481-2
GB 1011-1						-*	-*	+		-*		
GB 1011-2						-*	-*	-*		+		
GB 1012-1	-	-*		-*	-*			-*	-		-*	-*
GB 1012-2	-	-*		-*	-*			-*	-		-*	-*
GB 1167-1	-	-*		+	-*	-*	-*				-*	-*
GB 1167-2	-	-*				-	-					
GB 1167-5				-*	+						+	+
GB 1481-1		-*	-*			-*	-*	-*		+		
GB 1481-2		-*	-*			-*	-*	-*		+		

Fig. 6. Confrontations in Peniophora limitata. -* = Mycelium from confrontation line were subcultured in malt liquid and grown on slides under a collodion film. Clamps absent on MA dishes but present in subcultures.

Phlebia livida (Fr.)Bres.

Material:

GB 0395/ Abies/ Austria, Steiermark/ 1 PS.
GB 1283/ deciduous wood/ Sweden, Skåne/ 2 SS.
GB 1455/ Fagus/ Sweden, Västergötland/ 1,2,3,5,6,/4.
GB 1509/ deciduous wood/ Romania, Brasov/ 6 SS.
GB 1518/ Fagus/ Romania, Neamt/ neohaploidized PS-culture used in mating tests.
GB 1798/ Fagus/ Spain, Huesca/ 1/2,3.
GB 1812/ Fagus/ Spain, Huesca/ 1,4/2,3,5.
GB 1814/ Abies/ Spain, Lerida/ 1,2,6,7,8,10/3,4,5,9.

GB 0301/ Picea/ Sweden, Östergötland/ 1,3/2,4.
GB 1290/ Picea/ Sweden, Halland/ 1,2,3,4/5.

Two compatibility groups have been distinguished:

Group 1. GB 301, GB 1290. Both specimens were collected on Picea.
Group 2. GB 395, GB 1283, GB 1455, GB 1509, GB 1518, GB 1798, GB 1812, GB 1814.

	GB 395-PS	GB 1283-1	GB 1283-2	GB 1455-1	GB 1455-2	GB 1455-4	GB 1509-1	GB 1509-2	GB 1518-PS	GB 1659-1	GB 1659-2	GB 1798-1	GB 1798-2	GB 1812-1	GB 1812-2	GB 1814-1	GB 1814-3	GB 301-1	GB 301-2	GB 301-3	GB 301-4	GB 1290-1	GB 1290-5
GB 1283-1	+			+	+															–	–	–	–
GB 1283-2	+			+	+															–	–	–	–
GB 1455-1		+	+				+	+	+			+	+	+	+	+	+					–	–
GB 1455-2		+	+																			–	–
GB 1455-4							+	+	+			+	+	+	+	+	+						
GB 1509-1				+		+			+													–	–
GB 1509-2				+		+			+													–	–
GB 1518-PS				+		+	+	+														–	–
GB 1659-1												+	+	+	+	+	+						
GB 1659-2												+	+	+	+	+	+						
GB 1798-1				+		+				+	+			+	+	+	+	–	–			–	
GB 1798-2				+		+				+	+			+	+	+	+	–	–			–	
GB 1812-1				+		+				+	+	+	+			+	+	–	–			–	
GB 1812-2				+		+				+	+	+	+			+	+	–	–			–	
GB 1814-1				+		+				+	+	+	+	+	+			–	–			–	
GB 1814-2				+		+				+	+	+	+	+	+			–	–			–	
GB 301-1												–	–	–	–	–	–						
GB 301-2												–	–	–	–	–	–						
GB 301-3		–	–																			+	+
GB 301-4		–	–																			+	+
GB 1290-1		–	–	–	–		–	–	–			–	–	–	–	–	–			+	+		
GB 1290-5		–	–	–	–		–	–	–											+	+		

Fig. 7. Confrontations i Phlebia livida.

Complete intercompatibility within respective group, incompatibility between them (fig. 7). In basidiocarp morphology the representatives of the two groups are almost identical. Only, the number of tubercles on the hymenial surface is somewhat higher in group 2 than in group 1. Like in Hyphodontia subalutacea, there seem to be a distinction between a "coniferous type" and a "broad-leaved type", here also including Abies.

Radulomyces confluens (Fr.)M.P. Christ.

Material:
GB 0074/ Sambucus/ Denmark, Jutland/ 1,7,9,10/3,8.
GB 0733/ Alnus/ Canada, Ontario/ 1/2.
GB 1062/ Rosa/ Romania, Harghita/ 1 PS.
GB 1071/ deciduous wood/ Romania, Bistrita-Nasaud/ 6 SS.
GB 1705/ deciduous wood/ Finland, North Häme/ 3,5/4,6.
GB 1818/ Fagus/ Spain, Navarra/ 1/3,4.
GB 1875/ deciduous wood/ Spain, Lerida/ 2 SS.

Intercompatibility between above mentioned specimens. No morphological differences noticed.

Resinicium bicolor (Fr.)Parm.

Material:
GB 0046/ coniferous wood/ Sweden, Skåne/ 1,3,4/2.
GB 0391/ Abies/ Austria, Steiermark/ 1,2/3.
GB 0927/ coniferous wood/ Scotland, Perthshire/ 1/2.
GB 1026/ Picea/ Romania, Bistrita-Nasaud/ 5 SS.
GB 1195/ Norway, Hordaland/ 1,2,3,5/4.
GB 1308/ Picea/ Sweden, Gotland/ 1,2,4,6/3,5.
GB 1821/ Abies/ Spain, Lerida/ 1,5,6,7,8,9/2,3,4.
GB 1827/ Abies/ France, Pyrenees Orientales/ 1,4,5/2,3.

Compatibility has been shown between these specimens, and no morphological differences noticed between the corresponding basidiocarps. A specimen from Canada is partially compatible with the European ones and differs morphologically by somewhat smaller spores (Hallenberg, 1984).

Sistotremastrum suecicum Litsch. in John Erikss.

Material:
GB 0745/ Pinus/ Canada, Ontario/ 1,3/2.
GB 0934/ Pinus/ Scotland, Perthshire/ 1,2,6/3,4,7.
GB 1741/ Pinus/ Finland, South Häme/ 3 SS.

GB 1512/ Picea/ Romania, Suceava/ 1,5/2,3,4,6.

Compatibility between GB 745, GB 934, GB 1741. These specimens are morphologically uniform in their basidiocarps and conform well with the description in Eriksson et al (1984). GB 1512 is incompatible with these specimens. It also differs in morphology by having a very thin basidiocarp and slightly wider spores (2,8 µm versus 2-2,5 µm).

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		48	for	phlebiaformis	read	phlebiaeformis
192	line	12	for	*A. osmophila*	read	*Ascosphaera osmophila*
437	line	31	for	C.	read	Cylindrotrichum
467	line	23	for	Tricothelium	read	Trichothelium
489	line	10	for	C. hyalochaeta	read	Cheilymenia hyalochaeta

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MATERIALS FOR A LICHEN FLORA OF THE ANDAMAN ISLANDS - IV PYRENOCARPOUS LICHENS

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ABSTRACT

Data on thirteen corticolous species of the lichen genera Astrothelium, Ditremis, Lithothelium, Melanotheca, Parmentaria and Trypethelium are presented. Ditremis corticata, D. verrucosa, Parmentaria albidopora and P. nilamburensis are described as new. All of these species represent additions to the lichen flora of the Andaman Islands.

INTRODUCTION

The present paper, the fourth in a series on the linchens of the Andaman Islands, India, includes thirteen corticolous species in six pyrenocarpous lichen genera, Astrothelium, Ditremis, Lithothelium, Melanotheca, Parmentaria and Trypethelium, none of them previously known from the area.

Sixteen species of foliicolous pyrenolichens in the genera Phylloblastia (1), Porina (7), Raciborskiella (1), Strigula (5) and Tricothelium (2) and thirty three species in the corticolous pyrenolichen genera Anthracothecium (4), Arthopyrenia (4), Clathroporina (1), Microthelia (2), Parmentaria (2), Pertusaria (1), Porina (14) and Pyrenula (5) have so far been described from the Andaman Islands by Nylander (1873), Jatta (1905), Santesson (1952) and Singh A. (1970 a, b, 1971, 1985).

Pyrenocarpous lichens, characterised by flask shaped (perithecia) ascomata, comprise one of the major groups of lichens in the tropical rain forest ecosystem. The generic and family delimitations of this group of lichens, however, are still in flux as the nature of the ascospores (colour, shape of the cells) and the ascomata are considered in various ways by different lichenologists.

However, for the present, until the variations in ascocarps, ascus and ascospores are understood through morphological research on pyrenolichens, we will use artificial genera based on ascocarp type (Zahlbruckner, A. 1926, Müll. Arg., 1885, 1888). Eriksson and Hawksworth

(1985), actually, accepted many of these genera in their recent treatment of the Ascomycetes.

1. Astrothelium fallax Müll. Arg. in Engler Botan. Jahrbuch., 6 : 383, 1885. Zahlbruckner, A. Cat. Lich. Univ. 1 : 515, 1922. Figs : 9, 22

Type : Cuba, C. WRIGHT, s.n. Syntype - G (!)

Thallus corticolous, yellowish green, distinctly verrucose, cracked, glossy, K + yellow, P -ve; warts large, rounded or elongated, convex or almost globose; cortex 30-50 µm thick; algal layer 17-30 µm thick; ascomata black, carbonized, completely embedded in large thalline warts, externally visible by black or blackish brown ostiolar region, 2-4 opening into common ostiole; ascospores 8/ascus, hyaline, 4-locular, 16.5-27.5 x 6-8 µm in size.

Specimens Examined : Andaman Islands, South Andaman, Alexandria Island, Wandoor, 85.1037, 85.1043, 85.1068; Baratang Island, Bishnu Nala, 85.658, 85.659.

Remarks : Astrothelium Eschw., with 40 species (Hawksworth et al, 1983) on the world level is represented by only one species A. fallax Müll. Arg. in India.

Apparently, A. fallax reminds one very much of Campylothelium superbum (Fr.) Müll. Arg. on account of the similar morphology of the thallus and the pseudostroma but microscopic examination soon reveals fundamental differences.

2. Astrothelium subfuscum Krempelh. in Nuov. Giorn. Botan. Ital., 7 : 64, 1875. Zahlbruckner, A. Cat. Lich. Univ. 1 : 517, 1922. Figs : 1, 10, 23

Type : Singapore, O. BECCARI, 236-M (!), Holotype.

Thallus corticolous, olivaceous green, distinctly warty, K + orange, P -ve, corticated; cortex 33-82.50 µm thick; algal layer 30-86 µm thick; ascomata black, carbonized embedded in concolorous pseudostromata, externally visible as black ostioles surrounded by black, flattended periostiolar region; pseudostromata irregular in shape, 0.5-2.5 mm long, 0.5-1.2 mm broad, with white tops (due to the exposed medullary layer of the pseudostromata); ascospores 8/ascus, hyaline, ovate, 4-locular, with lenticular lumen, 23.1-26.4 x 7-8 µm in size.

Specimens Examined : South Andaman, Alexandria Island, Wandoor, 85.1101, 85.1121, 85.1126.

Remarks : Astrothelium subfuscum, is closely related to A. variolosum (Ach.) Müll. Arg. with regard to structure of the pseudostroma where the cortex of the pseudostroma bends back towards the bottom, skirting the ascoma, from which it can easily be distinguished by smaller pseudostromata and larger ascospores.

3. Ditremis corticata sp. nov. Figs : 4, 18, 31

Typus : Little Andaman, Netaji Nagar, Krishana Nala, 28.2.1985, P.G. PATWARDHAN & M.B. NAGARKAR, 85.865 (Holotype AMH, Isotype- BM).

Thallus olivaceo viridis, rimosus, verrucosus, endophloeodes; stratum corticale 16.5-66 µm crassum; ascomata in verruca thallina, 0.5-1.5 mm crassa, hemispherica inclusa, subhorizontalia, vel horizontalia, ostiolo laterali in papilla prominula ; asci 8-spori; ascosporae incolores, ellipsoideae, 1- septatae, in medio constrictae, 66-120 µm longae et 16.5-23 µm latae.

Thallus corticolous, olivaceous green, distinctly cracked and verruculose, corticated; cortex hyaline, 16.5-66 um thick; ascomata mostly completely immersed in concolorous, 0.5-1.5 mm thalline warts, sometimes appear as flattened, minute, black spots on the warts or by their ostioles; wall of the ascomata dark blackish brown, entire; ostioles blackish brown, obliquily oriented; ascospores 8/ascus, hyaline, 1-septate, broadly ellipsoidal, ends blunt, constricted at the septum, thick walled, 66-120 x 16.5-23 µm in size.

Remarks: None of the species of the known genus has a corticated thallus and large ascosores reaching a length of 120 um.

4. *Ditremis verrucosa* sp. nov. Figs : 19, 32

Typus: Middle Andaman, Long Island, on the way to Lalaji in evergreen forest, 22.2.1985, P. G. PATWARDHAN & M. B. NAGARKAR, 85.2096(Holotype- AMH, Isotype-BM).

Thallus, viridis, verrucosus, endophloeodes, stratum corticale 13.0-49.5 µm crassum; ascomata toto immersa in verruca thallina, solitaria, externe visa ut pallidum punctum ostiolum, subhorizontalia vel horizontalia; ascosporae hyalinae, ellipsoideae 1-septatae, medio constrictae, 33-88.5 µm longae et 13-18 µm latae.

Thallus corticolous, olivaceous green; verrucose, corticated; cortex 13-49.5 µm thick, hyaline; ascomata deeply embedded in large (2-3 mm in diameter), highly elevated concolorous thalline warts, externally visible as white or very light brown ostioles; ascospores hyaline ellipsoidal, 1-septate, 33-88.5 x 13-8 µm in size.

Remarks : The present species differs from *Ditremis corticata* in having distinctly warty thallus, white to pale brown ostioles and much smaller ascospores.

5. *Lithothelium paraguaense* Müll. Arg. in Reveue Mycolog. 10 : 27, 1888. Zahlbruckner, A. Cat. Lich. Univ. 1 : 513, 1922. Figs : 2, 11, 24.

Type : Paraguay, BALANSA 215, Lectotype - G (!)

Thallus corticolous, green, thin, smooth; algal layer situated deep in the thallus; ascomata 2-5 grouped together, opening into common, black, punctate ostiole, semi-emergent to emergent, black, horizontal, elongated, 0.4- 0.8 mm in diameter, totally carbonized; ascospores 8/ascus, hyaline, ellipsoidal to ovate, tranversely 1-3 septate, cells cubical, 8.4-16.5 x 3-4.5 µm in size.

Specimens Examined : North Andaman, Mayabander Range, Kaichi Nala, 85.2773, Interview Island, 85.2850, on way to Lamia Bay to Kalipur, S.E. of Aerial Bay, in mixed forest, 86.492; South Andaman, Baratang Island, 85.513, 85.525, 85.638; Little Andaman, Netaji Nagar, Krishana Nala, 85.917; Buttler Bay, 85.919, 85.935; Vivekanandpur, 85.988.

Remarks : The genus Lithothelium Müll. Arg. is known from only five species, L. Cubanum Müll. Arg. , L. violascens Malme, L. indicum Patwardhan, Makhija et Rane(1980) and L. neoindicum A. Singh (1986 a, b).

Lithothelium paraguaense is reported for the first time from India.

6. Melanotheca anomala (Ach.) Malme in Ark. Bot. 19(1) :30, 1924.Trypethelium anomalum Ach. in Syn. Lich. 105, 1814 (p.p. maj. acc. to Malme). Zahlbruckner, A. Cat. Lich. Univ.1 :487, 1922. Figs. 12 , 25.

Thallus corticolous, yellow to yellowish brown, smooth, delimeted by a black hypothalloidal region at the periphery, totally endophloedal, K-ve, P-ve; ascomata black, carbonized, minute, conical, flattened at the base; ostioles black, punctate, centrally situated; pseudostromata black, carbonized, 2-20 carpic, irregular, flattend, 0.5-3.5 mm long and 0.5-2.5 mm broad ; structure of the pseudostromata of the M. aggregata type with tissues of the pseudostromata together with the substratum cells carbonized; ascospores 8/ascus , brown, ovate, 4-locular, with lenticular lumen, 14-20 x 6-8.5 µm in size.

Specimens Examined : South Andaman, Pongibalu, Rutland, Kala Pahad, 85.585, 85.1177, 85.1199.

Other Specimens Examined : Africa ; Golungo, Sovado de Quilambo, ad Corticaticem Euphorbiacearum, C. WELWITSCH, 187, TUR- VAINIO 31225; Cuba, C. WRIGHT, Verru. Cub. 132, 169, 172 d, 174, 229 a, c, d, Ser. II, 599, 600- G.

Remarks : This species is reported for the first time from India.

7. Melanotheca arthonioides (Eschw.) Müll. Arg. in Flora, 67 : 128, 1884 . Verrucaria arthonioides Eschw. in Martius, Icon. Plant. Cryptog. , 1 : 15, 1828-1834. Zahlbruckner, Cat. Lich. Univ. 1 : 480, 1922.,in Mart., Icon. Plant. Cryptog. 2 : 15, 1827 (with description). Figs : 13, 26.

Type : Brazil, Cresit and corticem tenuem arborum prope para, Cayete Martius (not seen).

Thallus corticolous, crustose, brown, cracked, delimited by a thick, black hypothallodial region at the periphery, completely endophloeodal, K -ve, P -ve; ascomata black, carbonized, minute, aggregated in ± rounded or irregularly shaped, black pseudostromata; ostioles black, punctate, indistinct; pseudostromata poly carpic, 1.8-8 mm long and 1-3 mm broad, flattened; structure of the psendostroma as in M. aggregata; ascospores 8/ascus, brown, 4-locular, with lenticular or sub-globose lumen, ovate, 10-17 x 5-8 µm in size.

Specimens Examined : South Andaman, Pongibalu, Rutland, Kala Pahad, 85.1169.

Other Specimens Examined : Cuba, C. WRIGHT, Verr. Cub. 171, 172, 601, Ser. II 601-G., Colombia, LINDIG, 2794 - H. NYL. 7569, Cuba, C. WRIGHT, Verr. Cub. 172, TUR - Vainio, 31223.

Remarks : Melanotheca arthonioides can easily be distinguished from other species by its pseudostromata which resemble the ascocarps of Arthonia and Arthothelium (Arthoniaceae).

8. Melanotheca arthonioides var. grisea Müll. Arg. in Engler, Botan. Jahrbuch, 6 : 396, 1885. Zahlbruckner, A. Cat. Lich. Univ. 1 : 481, 1922. Figs. : 14,27

Type : Cuba, C. WRIGHT Verr. Cuba, 173 b, Lectotype - G (!)

Thallus corticolous, yellow, smooth, cracked, delimited by a black hypothalloidal region at the periphery, K -ve, P -ve; algal layer situated deep in the thallus, ascomata black, carbonized, aggregated; ostioles black, punctate, centrally situated, surrounded by thin, white, annular rim; pseudostromata black, carbonized, irregularly spreading, polycarpic, 1-7.5 mm long and 1-6 mm broad; ascospores 8/ascus, brown, 4-locular, lumen lenticular, 13-20 x 6-8 µm in size.

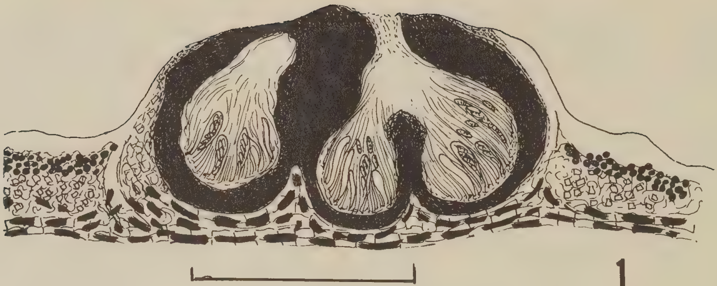
Specimens Examined : South Andaman, Wimberliganj, Kalatang, 85.86, 85.191, 85.192; Middle Andaman, Long Island, on the way to Lalaji, 85.2040.

Other Specimens Examined : Cuba, C. WRIGHT, Verr. Cuba, 173 a, Ser. II, 604-G.

Remarks : The present variety differs from M. arthonioides in having ostioles surrounded by a white annular rim.

9. Melanotheca leucotrypa (Nyl.) Müll. Arg. in Flora, 68 : 253, 1885. Trypethelium leucotrypum Nyl. in Flora, 50 : 9, 1867. Zahlbruckner, A. Cat. Lich, Univ. 1 : 482, 1922. Figs : 3, 15, 28

Figs : 1-8 - V.S. of pseudostroma. 1. Astrothelium subfuscum, 85.1126-AMH; 2. Lithothelium paraguaense, 85.919-AMH; 3. Melanotheca leucotrypa, 85.789-AMH; 4. Ditremis corticata, 85.865, Holotype-AMH; 5. Parmentaria albidopora, 85.500, Holotype-AMH; 6. Parmentaria nilamburensis, 85.320, Holotype-AMH; 7. Trypethelium eluteriae, 85.487-AMH; 8. Trypethelium ubianense, 85.2137-AMH. Scale = 500 µm.



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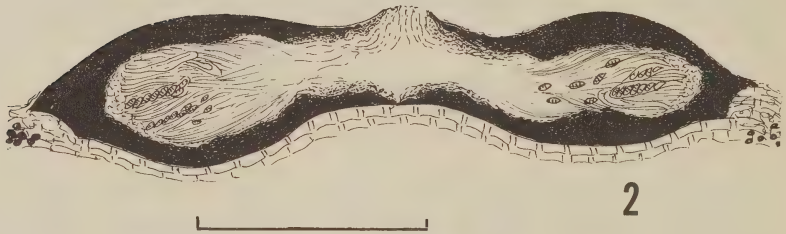

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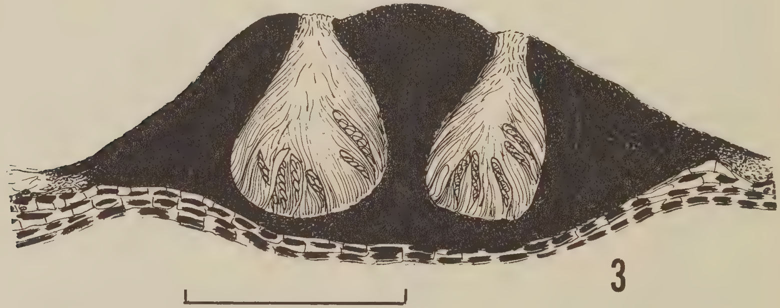

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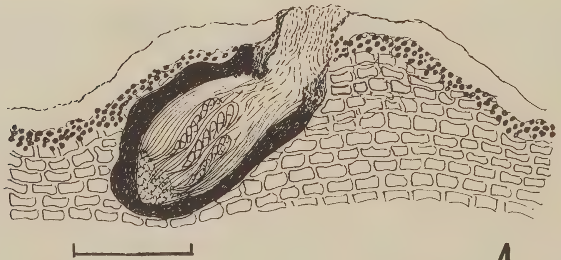

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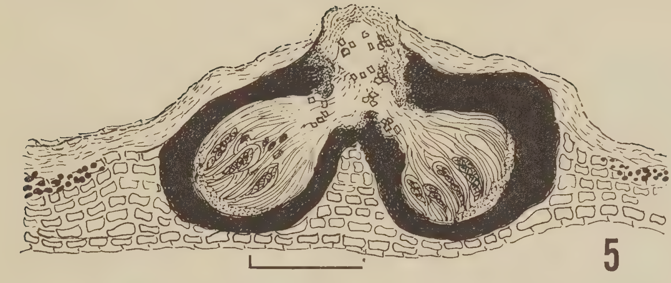

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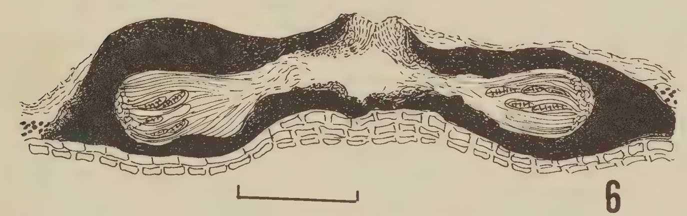

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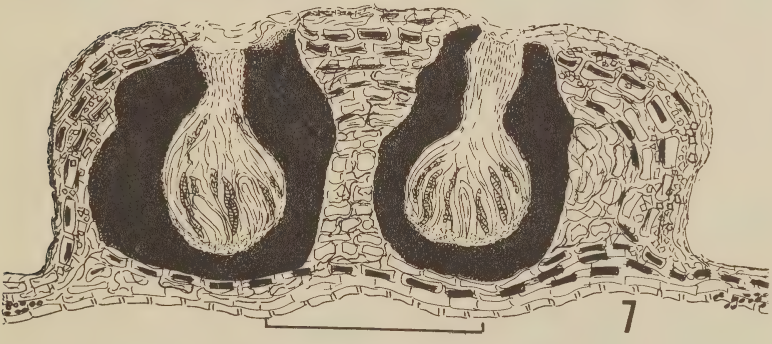

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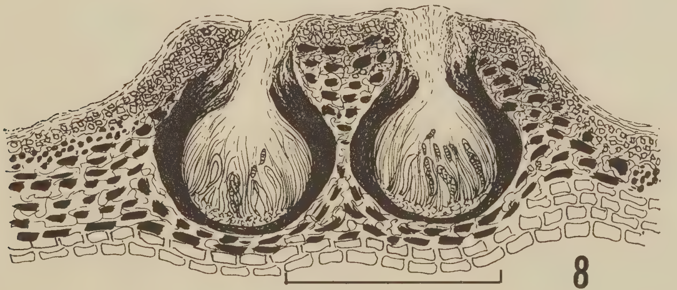

8

Type : Calcutta, Botanical Gardens, S. KURZ, 12 Lectotype H-NYL. 285 (!).

Thallus corticolous, yellowish brown to brown, more or less smooth, cracked, corticate, K + red, P -ve; cortex hyaline, 33-120 µm thick; ascomata black, carbonized, hemispherical, embedded in pseudostromata; ostioles black, punctate, centrally situated, surrounded by a white periostiolar region; pseudostromata black, carbonized, elevated, 1-12 carpic, 1.0-4.5 mm long and 1-3 mm broad; structure of the pseudostromata similar to *M. aggregata*, the cortical layer and the algal layer breaking at the level of the thallus and the substratum cells mixed with some hyphae and becoming carbonized; ascospores 8/ascus, brown, 4-locular, with lenticular lumen, ellipsoidal, 13-23 x 6-10 µm in size.

Specimens Examined : South Andaman, Baratang Island, Baludera, Mangrove forest, 85.758, 85.785, 85.789.

Other Specimens Examined : Calcutta, S. KURZ. 222 G, H-NYL. 286, S. KURZ. 12, H-NYL. 284.

Remarks : *M. leucotrypa* closely resembles *M. arthonioides* var. *grisea* in having more or less the same pseudostromata and ascospores. Variety *grisea*, however differs in having rather smaller ascomata, larger pseudostromata, and a thin, white ostiolar rim. In *M. leucotrypa* the white annular rim surrounding the ostioles is prominent.

10. *Parmentaria albidopora* sp. nov. Figs : 5, 16, 29.

Typus : South Andaman, Baratang, Nilambur, 22.2.1985, P.G. PATWARDHAN, M.B. NAGARKAR, & P.K. SETHY, 85.500 (Holotype-AMH, Isotype-BM.

Thallus uniformis, cinereus vel brunneus, endophloeodes, hypothallo nigricante limitatus; ascomata convexa, rotundata vel oblonga, nigra, 2-5, obliqua in ostiolum commune rectum, confluentia, ostiola albida vel ebureno, conspicuo; asci 8-spori; ascosporae fuscae, oblongo - ellipsoideae, muriformia, 8 loculares, loculi 3-5 locellati, 30-50 µm longae et 13-23 µm latae.

Thallus corticolous, grayish brown to brown, smooth, endophleodal, studded with crystals delimited by a black hypothalloidal region at the periphery; ascomata black, carbonized, in groups of 2-5, strongly emergent, opening

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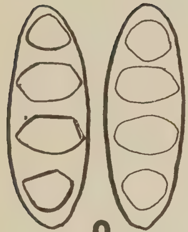
Figs : 9-21 - Ascospores. 9. *Astrothelium fallax*, 85.1068-AMH; 10. *Astrothelium subfuscum*, 85.1126-AMH; 11. *Lithothelium paraguaense*, 85.919-AMH; 12. *Malanotheca anomala*, 85.1199-AMH; 13. *Malanotheca arthonioides*, 85.1169-AMH; 14. *Melanotheca arthonioides*, var. *grisea* 85.191-AMH; 15. *Melanotheca leucotrya*, 85.789-AMH; 16. *Parmentaria albidopora*, 85.500, Holotype-AMH; 17. *Parmentaria nilamburensis*, 85.320, Holotype-AMH; 18. *Ditremis corticata* 85.865, Holotype-AMH; 19. *Ditremis verrucosa*, 85.2096, Holotype-AMH; 20. *Trypethelium eluteriae*, 85.487-AMH; 21. *Trypethelium ubianense*, 85.2137-AMH;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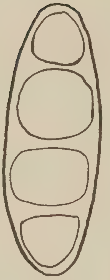
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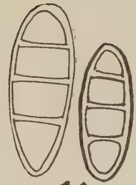
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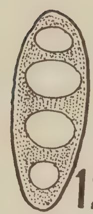
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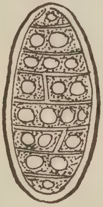
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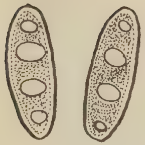
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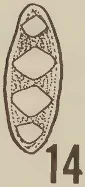
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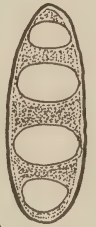
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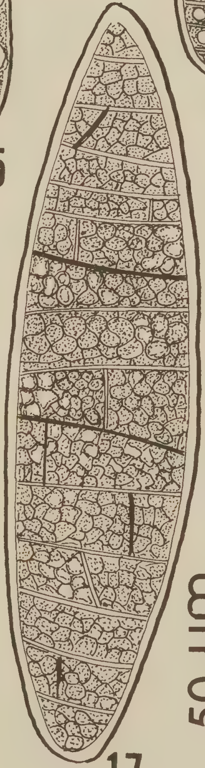
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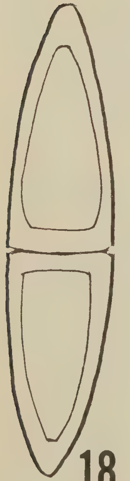
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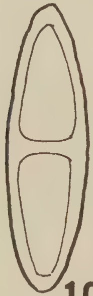
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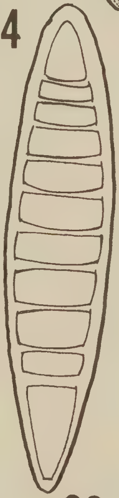
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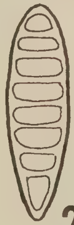
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16-19

50 µm

10 µm

into prominent, white, widely open, common ostiole; ostioles with long, white, protruding neck, studded with crystals; ascomata hemispherical, 0.5 to 1.2 mm in diameter, sometimes appear to be elongated due to long protruding neck; ascospores 8 /ascus, olivaceous brown to dark brown, ovate, muriform, mostly 7 septate, 1-5 lacuneate per tier, 30-50 x 13-23 µm in size.

Specimens Examined : South Andaman, Baratang, Nilambur, 85.457 , 85.496, 85.505.

Remarks : *P.albidopora* is readily distinguished from closely related *p. baileyi* Müll. Arg. by the ascocarps having a long, white, prominent protruding neck and concolorous, prominent, ostioles.

11. *Parmentaria nilamburensis* sp. nov. Figs : 6, 17, 30.
Typus : South Andaman, Baratang, Nilambur, 22.2.1985, P.G. PATWARDHAN, M. B. NAGARKAR & P. K. SETHY, 85.320 (Holotype-AMH, Isotype- BM).

Thallus ochraceous, distincte rimosus, endophloeodes; ascomata ut plurimum 2-5 apprpximata et collo obliquo ostiolo communi praedito confluentia, horizontalia emergentia convexa , usque 1.0 mm lata; ascosporeae 2-nae, parenchymatosae, fuscae, circa 82-218 µm longae et 30-46 µm latae.

Thallus corticolous, buff to ochraceous, distinctly cracked, endophloeodal, algal layer situated deep in the bark; ascomata strongly emergent, black, carbonized, hemispherical to elongated, 2-5 in a group, opening into black, common ostiole, 0.8-1.1 mm long; ascospores 2/ascus, brown, elongate-ovate or ellipsoidal, muriform, transversly and vertically multiseptate, parenchymatous, 82-218 x 30-46 µm in size.

Specimens Examined : South Andaman, Baratang, Nilambur, 85.320, 85.375, 85.376, Baludera, 85.789.

Remarks : The ochraceous, cracked thallus; strongly emergent, horizontal, ascomata with a black, wide, prominent ostiole and large ascospores reaching a length of 220 µm distinguish *P. nilamburensis* from the closely related *P. subastroidea* Müll. Arg. [Queensland, SHIRLEY, 1863 Lectotype- G.] which, however, has more or less similar external morphology but a glaucous, glossy thallus, semi-emergent ascomata having brown punctate ostioles surrounded

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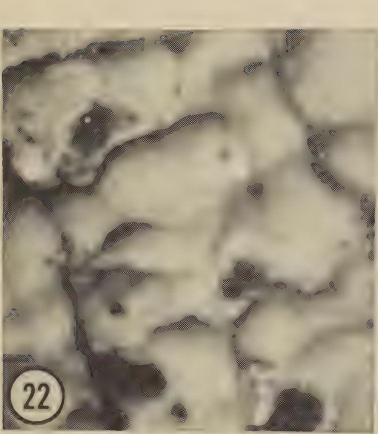
Figs : 22-34. 22. *Astrothelium fallax*, 85.1068-AMH; 23. *Astrothelium subfuscum*, 85.1126-AMH; 24. *Lithothelium paraguaense*, 85.919-AMH; 25. *Melanotheca anomala*, 85.1199-AMH; 26. *Malanotheca arthonioides*, 85.1169-AMH; 27. *Melanotheca arthonioides*, var. *grisea*, 85.191-AMH; 28. *Melanotheca leucotrypa*, 85.789-AMH; 29. *Parmentaria albidopora*, 85.500, Holotype-AMH; 30. *Parmentaria nilamburensis*, 85.320, Holotype-AMH; 31. *Ditremis corticata*, 85.865, Holotype-AMH; 32. *Ditremis verrucosa*, 85.487-AMH; 33. *Trypethelium eluteriae*, 85.2096, Holotype-AMH; 34. *Trypethelium ubianense*, 85.2137-AMH. scale = 1 mm.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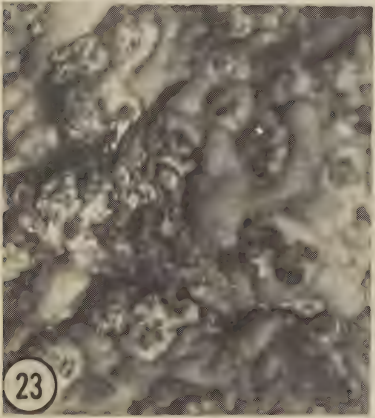
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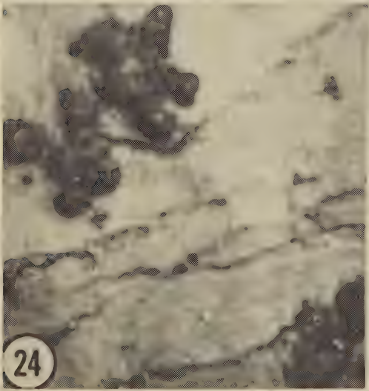
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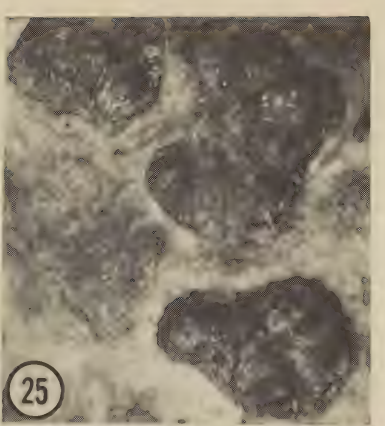
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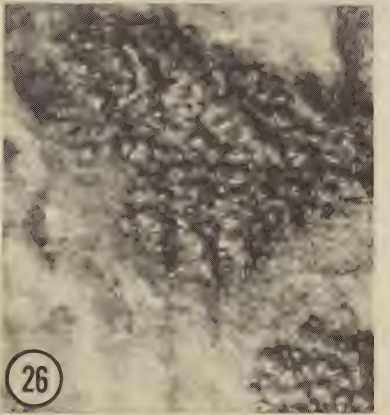
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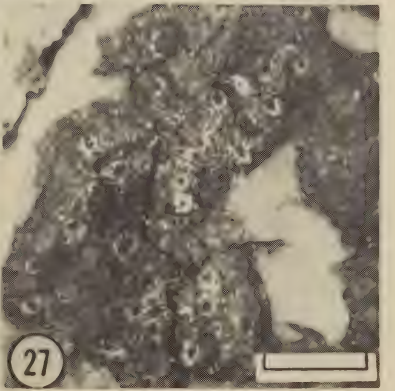
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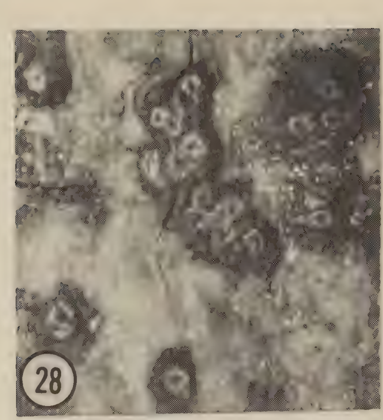
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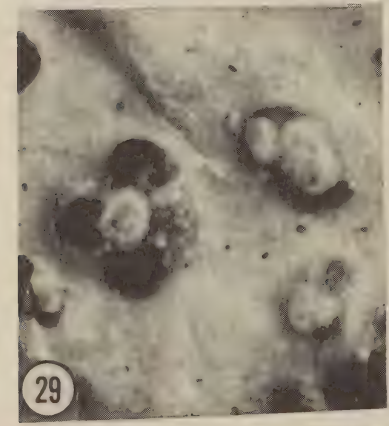
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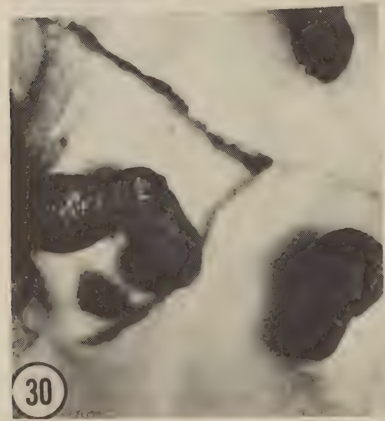
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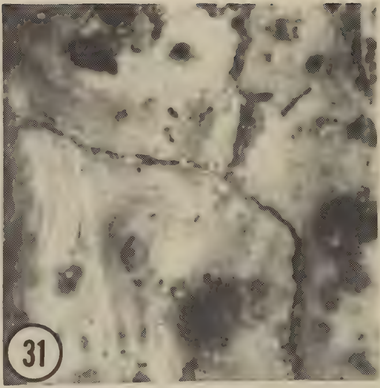
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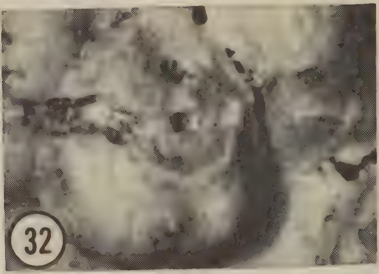
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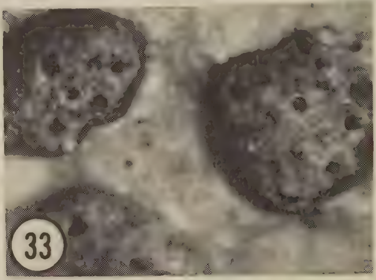
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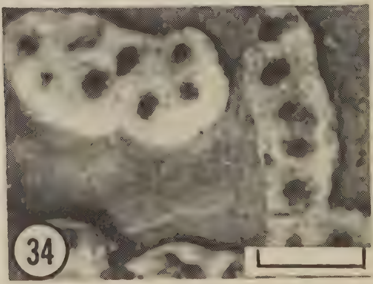
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by pale brown to white rim and much smaller ascospores (99-165 x 39- 45 um).

12. Trypethelium eluteriae Sprengel in Einleitung in das Studium der Kryptog. Gewachse, p. 351, 1804. Zahlbruckner, A., Cat. Lich. Univ. 1:490, 1922.
Figs : 7, 20, 33

Thallus corticolous, pale brown, smooth, glossy, totally endophloeodal; algal layer situated deep in the thallus, 10-35 µm thick; ascomata black, carbonized, vertically elongated, embedded in yellow to yellowish brown rounded to orbicular or elongated, highly elevated pseudostromata; pseudostromata 1-12 carpic, 1-4 mm long and 1-3 mm broad, cortical layer totally endophloeodal, divided into two with a thin layer extending to the ostiolar region and most of it below the ascomata, the medullary layer highly studded with crystals, K + purple and mixed with the bark cells forming tissue of the pseudostromata; ascospores 8/ascus, hyaline, fusiform, transversely 5-13 septate, with cells lenticular to cubical, some times 30-50 x 8-11 µm in size.

Specimens Examined : South Andaman, Baratang, Nilambur, 85.402, 85.487; Middle Andaman, Long Island, on the way to Lalaji, 85.2024.

Other Specimens Examined : India, Calcutta, S. KURZ 9 H-NYL. 229, 6, H-NYL. 232. Colombia, LINDING 2893-H-NYL Indo China, Annam, Nha-trang and vicinity, C.B. ROBINSON, 1409. TUR-Vainio 30726, 1410, TUR-Vainio 30727.

Remarks : The genus Trypethelium Sprengel, with 100 species (Hawksworth et al, 1983) on the world level distributed mainly in tropical regions, is reported for the first time from the Andaman Islands.

T. eluteriae Sprengel can be distinguished easily by the yellow to yellowish brown coloured, rounded, orbicular, highly elevated, constricted, polycarpic pseudostromata with the medullary region K + purple.

13. Trypethelium ubianense (Vainio) A. Zahlbr. in Cat. Lich. Univ. 8:129, 1932. Pseudopyrenula ubianensis Vainio in Ann. Acad. Sci. Fenn., Ser. A, 15(6):353, 1921.
Figs : 8, 21, 34

Type : The Philippines, Ubian Island. Ad corticem arboris, E.D. MERRILL, 5403 - Lectotype, TUR-Vainio - 30798 (!)

Thallus corticolous, grayish green, thin, totally endophloeodal, evanescent, K -ve, P -ve; algal layer situated deep in the thallus; ascomata black, carbonized, globose, completely embedded in pseudostromata; ostioles black, punctate to disc like, flattened; wall of the ascomata striate at the ostiolar region; pseudostromata white, rounded, orbicular, linear, constricted at the base, flattened to moderately elevated above the thallus, 1-20 carpic, 1-3.5 mm long and 0.8-1.5 mm broad; tissue of the pseudostromata consisting of the brown filaments mixed with a large number of crystals surrounding the ascomata together with bark cells; ascosores 8/ascus, hyaline, fusiform, ellipsoidal, transversely 5-10 septate, lumen of the cells lenticular, 30-36.3 x 6.6-9.9 µm in size.

Specimens Examined : Middle Andaman, Guitar Island, 85.2135, 85.2136, 85.2138, 85.2137, 85.2149.

Remarks : *Trypethelium ubianense*, seems close to *Trypethelium duplex* but the structure of the pseudostromata is much different. *T. duplex* invariably has 4-locular ascospores.

ACKNOWLEDGEMENTS

We are grateful to Mr. S.C. Gupte, Ex. Conservator of Forests, Andaman and Nicobar Islands, India for his help in the field work, and to the Directors/keepers of the herbaria of BM, G, H and TUR for the loan of type specimens preserved in their herbaria. We are also grateful to Dr. M.E. Hale, Smithsonian Institution, Washington D.C. and to Dr. R.C. Harris, New York Botanical Garden, Bronx, New York, U.S.A. for critical review and valuable suggestions.

We are thankful to the Department of Science and Technology, New Delhi, India for financial support.

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CHEILYMENIA FRAUDANS AND REMARKS ON THE GENERA CHEILYMENIA AND COPROBIA

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ABSTRACT: *Cheilymenia fraudans* (Karst.)Boud. is described and illustrated by line drawings according to the author's examination of the type of *Peziza fraudans* (Karst.) Karsten. *C. fraudans* is a well founded species clearly distinguished from *Cheilymenia raripila* (Phill.)Dennis and related species by its rooting hairs and much smaller subglobose ascospores with different ornamentation of perisporium. The ascospore size, shape and ornamentation differentiate *C. fraudans* from other species of the genus *Cheilymenia* too.
C. fraudans sensu Gamundí (1960) is quite a different fungus considered here to be a species of *Coprobia* Boud. emend. J. Moravec (1984,1986), the new emendation is formally made in this present paper. The importance of the perisporial ascospore ornamentation and striation for generic delimination between *Cheilymenia* (Boud.) and *Coprobia* Boud.emend.nov. is discussed.

Peziza fraudans (Karst.) Karsten (1871) (= *P.subhirsuta* Schum. **fraudans* Karsten (1870), transferred to the genus *Cheilymenia* Boud. by Boudier (1907) was insufficiently known species. The reexamination of the type has revealed that individual authors have treated this taxon in different conceptions.

CHEILYMENIA FRAUDANS (Karsten)Boudier, Hist.Class.Disc.Eur. p.63, (1907).
Peziza subhirsuta Schum. **fraudans* Karsten, Not.Sällsk. pro Fauna et Fl. fennica XI, p. 229. (1870).
Peziza fraudans (Karst.)Karsten,Mycologia fennica p.65,(1871).
Neottiella fraudans(Karst.)Saccardo,Syll.Fung.8:191,(1889).

1. The original Karsten's description (latin diagnose), described originally in an infraspecific value as *Peziza subhirsuta* **P. fraudans* Karsten (1870), later in the specific rank- *Peziza fraudans* Karsten (1871):

"Supra terram argillaceam, materia viridi obductam, in Mustiala mense ineunte Julio semel inventa.- Apothecia gregaria, planiuscula, aurantiaco-lutea, pilis raris, sordidis, articulatis, subaequalibus, brevibus (longit. 150-200 µm) adspersa, latit. 1.5-2 mm; sporae ellipsoideae, eguttulatae, monostichae, longit. 18-21 µm, crassit 13-14 µm (immixtis aliis minoribus = junioribus longit. 12-15 µm, crassit 10 µm), thecae cylindraceae, apice iodo non tinctae, longit. 240-280 µm, crassit. 16-25 µm; paraphyses filiformes, articulatae, in vivo statu granulosae et aurantiaco-fulvae, crassit. 4 µm, apice incrassato crassit. 8-10 µm." (Karsten 1870, p. 229).

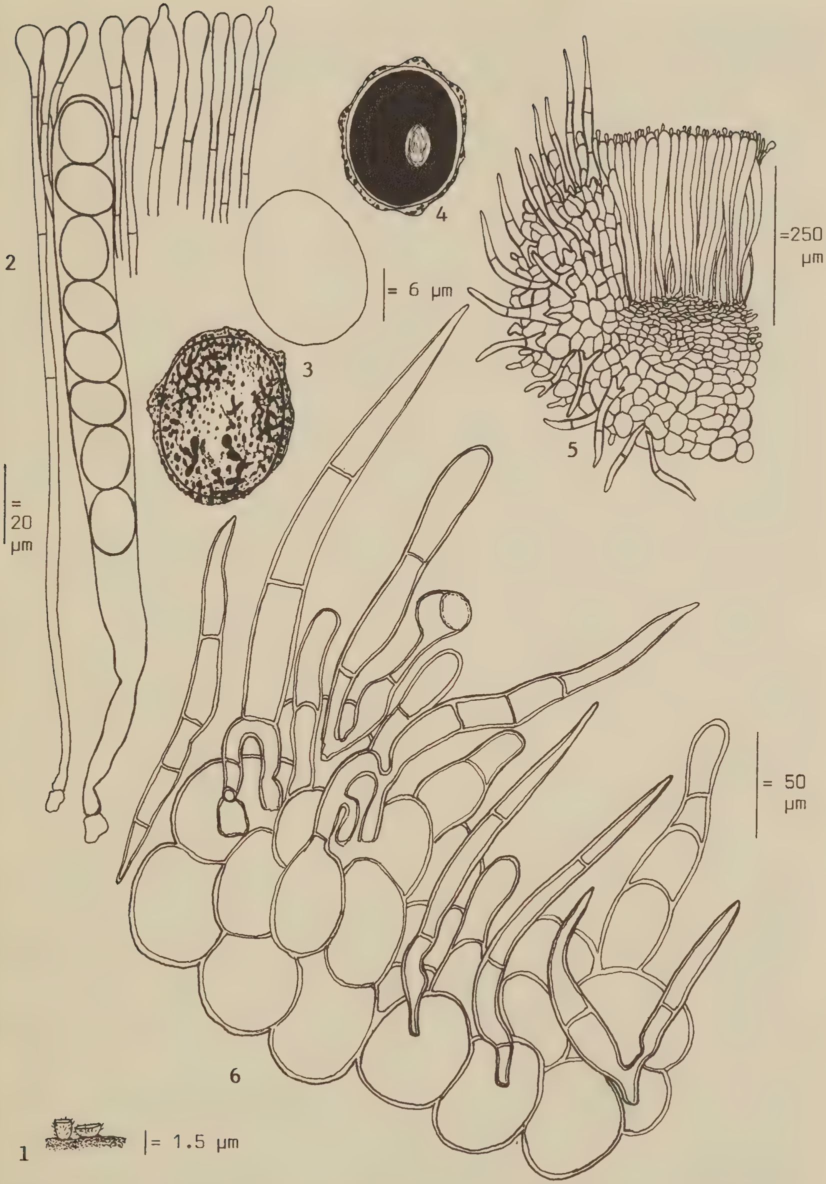
2. Description according to the examination of the type (five dried apothecia densely crowded on a substrate; only one of the three apothecia examined was found fully mature:

One apothecium turbinate with a flat thecium (immature), the other apothecia cupulate with a flattened thecium, sessile, 0.8-1.5 mm diam.,dark orange brownish (when dried), outer surface and margin covered with inconspicuous pale hairs. Excipulum in the inner (medullare) layer comprising of angular to ellongated almost hypha-like cells 4-10 µm thick, forming an atypical textura angularis to textura subintricata to subepidermoidea under the hypothecium and in the hypothecium,the cells are with thin walls; ectal excipulum comprising of globose to ellipsoid or angular cells(15-75 µm diam.) with thin (0.5-0.8 µm) hyaline walls, forming a textura globulosa-angularis, the cells are elongated towards the ectal surface in the marginal part of apothecia, the marginal cells are with thickenned (up to 1.5 µm) yellow-brown walls (of the same colour as the excipular hairs). Hairs 68-270 x 8-19 µm, arrising from the ectal excipulum, septate, pale yellow-brownish, often with hyaline tops, mostly irregularly curved or straight,with pointed or blunt apex, rooting at their base; the roots ocassionally inflated, originating from the ectal excipular cells, but terminated roots also occur,often the base of hairs is simple and attenuated and truncate (in one hair even pointed),so it is evident that these hairs originate within the excipular tissue. Asci 230-255 x 13.5-17 µm, cylindrical, with a blunt apex and attenuated base, eight-spored. Paraphyses filiform, 2.7-3.5 µm thick, sparcely septate, straight, apex slightly to conspicuously enlarged (4.5-8-10.5 µm), clavate or pyriform to ampullaceous, containing an yellowish pigment. Ascospores 16,5 - 19.5 - (19.8) x 12 - 13.5 - (13.8) µm, broadly ellipsoid or subglobose, hyaline at maturity, with a pealable perisporium; the perisporium covered with irregular cyanophylic warts and short anastomosing ribs forming occasionally an irregular and very incomplete reticulum. Immature ascospores with a thick cyanophilic plasma.

Material examined: Only the type collection (H 2226) cited above in the Karsten's original diagnose.

Cheilymenia fraudans is well distinguished from other species of the genus Cheilymenia Boud. and also from species of the genus Coprobia Boud. emend J.Moravec (1984,1986). The genus Coprobia, with the type species Coprobia granulata (Bull.)Boud. which includes in this sense also a group of species having superficial hairs originating from the excipular cells (represented by Coprobia theleboloides (Alb. et Schw.) J.Mor. and related species), differs from the genus Cheilymenia not only by the mentioned shape of hairs, but also by the perisporium of ascospores covered with rib-like longitudinal cyanophilic striation (J.Moravec 1984, 1986), which I consider an important feature for the generic delimination between Cheilymenia and Coprobia too.

Brummelen (1986),without any note or explanation, treated Peziza fraudans Karst. as a synonym of Cheilymenia raripila (Phill.) Dennis. However, C. raripila differs distinctly in


2
4
=250 µm
= 6 µm
3
= 20 µm
5
= 50 µm
6
1
= 1.5 µm

Figs. 1-6. Cheilymenia fraudans. 1. Apothecia. 2. Ascus and paraphyses. 3. Mature ascospores. 4. Immature ascospore (all illustrated ascospores under oil immersion x 1600 + CB. 5. Section of the marginal part of the apothecium. 6. A part of the ectal excipulum with apothecial hairs. (Type (H)).

many important features, e.g. much larger ascospores, different ascospore ornamentation, and a different shape of hairs which are superficial, not broadly rooting at their base. Moreover, C. fraudans sensu Gamundí (1960) is not identical with the original Karsten's taxon. Gamundí (1960) noted that she did not examine the type. I have not examined the Argentinian material described and illustrated by Gamundí (1960) under this name, but according to the description and illustration, it clearly differs from the Karsten's type specimen. The ascospores of the Argentinian collection are described much more ellipsoid and of a different size (15.6 - 18.9 x 10.8-11 µm, and with a longitudinal perisporial striation, the hairs are of a different type, conspicuously superficial with a bulbous base as originating from excipular cells, and, the paraphyses are slender above. This seems to be a species of Coprobia related to C. theleboloides, but, of course, this cannot be stated with certainty without examining of the Argentinian collections. Coprobia hyphopila J.Moravec (1984) differs from the Argentinian fungus by much longer (up to 1000 µm) hypha-like, flexuous to subspiral hairs (though the base of these superficial hairs is similar in both species), which distinctly differs from the rooting hairs of Cheilymenia fraudans, too.

In my opinion, C. fraudans is a species which is congeneric with Cheilymenia ciliata (Bull.) Maas Geesteranus, although I have not found the yellow refractive colour in mature ascospores of the type when stained by Cotton blue in lactic acid, which is one of the features of the genus Cheilymenia. However, it maight be caused by the fact that I cut only a very little section of one mature apothecium possessing several mature ascospores only, as the other two apothecia examined were immature. In my experience, also a certain number of mature ascospores in other species of Cheilymenia is hyaline.

The habitat, according to the Karsten's diagnose, remains uncertain (terestrial?) whilst in the type specimen the apothecia seems to grow on an excrement. I suppose that it is a coprophilous species.

As it has been noted in the description, I have found one apothecial hair having a pointed base of a shape resembling hairs in species of the genus Trichophaeopsis Korf et Erb (1972), whilst other hairs were rooting or with a simple, attenuated and truncate base (hairs with attenuated truncate base also occurs in Trichophaeopsis). However, this genus is distinguished especially by its excipular structure, which consists of smaller angular cells regularly arranged in vertical raws towards the margin of apothecia, and, by much thiner paraphyses (1.5 - 3 µm thick at their apex).

Reexaminations of the type of Trichophaeopsis latispora J. Moravec (1979) and of collections of Trichophaeopsis bicuspis (Boud,) Korf et Erb has confirmed the basic differences. Moreover, no species of Trichophaeopsis , Trichophaea Boud., Tricharina Boud. and Wilcoxina Yang et Korf (1985) have such rooting hairs as those which are present in C. fraudans.

Also the genus Neottiella (Cooke) Sacc. emend Boud.,including its broader sense in which Neottiella is merging with Leucoscypha Boud., distintly differs.

In my opinion, the most closely related species to *C. fraudans* is *Cheilymenia humarioides*(Rehm) Gamundí sensu Gamundí (1972). According to the description and illustration (Gamundi 1972, 1975), *C. humarioides* differs by larger ascospores (19 -25.9 x 10.6 -14 µm) with a smooth perisporium. The other features, especially the hairs are very similar in both taxa. I have not examined the neotype of *C. humarioides* based on one of the Argentinian collections and stated by Gamundí (1972). However, I have examined two collections from Greenland kindly send to me by Dr. Henri Dissing, Kobenhaven: East Greenland, Mestersving near Nyhavn, on dung of Barnacle goose, 5.VIII. 1983, and on the same locality on summer dung of Muskox, 2.VIII. 1983 leg. H. Dissing. I have found the ascospores of these two collections, which I have determined as *C. humarioides*, smooth or with a finely punctate perisporium. In other features, they well correspond with the Gamundí's description and illustration of the neotype of *C. humarioides*, and differ in ascospore size and ornamentation from *C. fraudans*.

The ascospore ornamentation in *C. fraudans* is of the perisporial origin, and, the perisporium is pealable and can be easily deformed after the sections, stained in Cotton blue in lactic acid , were heated. Unfortunately, I cannot prepare a specimen to take SEM photomicrographs as the type material is very scanty, but the ornamentation is clearly seen by light microscope.

On this occasion, I wish to emphasize again the existence of the original perisporial ascospore ornamentation in *Cheilymenia* and *Coprobia*, which can be observed before the deformation of the perisporium, and, represents an important feature discussed in J.Moravec (1984). The rib-like character of the original perisporial striation in ascospores of *Coprobia* has been also proved by SEM photomicrographs taken from dried specimens (J.Moravec 1986). Recently, I have examined ascospores of *Cheilymenia raripila*, *Cheilymenia hyalochaeta*(Speg.) Gamundí (1960) and *Cheilymenia notabilispora* J.Moravec (1968, 1984), and found an outstanding original perisporial ornamentation. This ornamentation, already described and illustrated by Gamundí (1960) in ascospores of *C. hyalochaeta*, is well seen by light microscope, and, we have it now proved by SEM too (yet unpublished results). In spite of the fact, Brummelen (1986) has illustrated and described a deformed and wrinkled perisporium of one ascospore in *C. raripila*, and, has considered it merely a secondary wrinkling caused by the heating in lactic acid. However, as it was already discussed (J.Moravec 1984), in light microscopy, it is necessary to recognize the original perisporial ornamentation, clearly seen before the heating, as distinct from the secondary deformation of perisporium caused by the heating or longer action of lactic acid. Therefore, it is necessary to use such Cotton blue in lactic acid, which stains promptly without heating (CB Geigy s.123).The ornamentation is strongly cyanophilic and clearly observable, in a case of *C. raripila* even by a dried objective, and seen also in the optical section of ascospores. Provided that the sections are stained without heating, the perisporium in majority of ascospores of *C. raripila* is very resistant and the ornamentation is clearly seen after ten and more years on stored slides prepared by such simple method, even when the CB was dried up and the sections had to be revived again. The cyanophilic ornamentation is clearly seen on ascospores with perfectly regular and tense perisporium without any deformation, and can be seen on the deformed or separated perisporium too.

In its features, e.g. the shape and type of hairs and the pealable ascospore sheat (perisporium), *C. fraudans* agrees with those species,which,after the new emendation of *Coprobia*, remains in the genus *Cheilymenia* Boud.
The new emendation of the genus *Coprobia* follows:

COPROBIA Boudier, Bull.Soc.Mycol.Fr.1:107,(1885), **emend nov.**
Apothecia turbinata, doliiformia,convexa vel moliter patelliaria, sessilia, usque explanata, thecio plano vel usque pulvinato, luteo, luteo-ochraceo, aurantiaco-luteo vel aurantiaco, raro etiam sordide albido-subochraceo; pars exterior apothecii minute vel crasse granulata, glabra sed parte basali cum hyphis sparsis superficialibus, hyalinis, septatis, vel etiam pars exterior apothecii pilis sparsis tota obsita. Pili superficiales, parte basali simplices, e cellulis globosis excipuli excrescentes, (raro etiam ramosae sed ramis brevibus, superficiales, obtusi, e cellulis excrescentes), hyphoidei et flexuosi vel recti, septati, tenuiter tunicati, hyalini vel lutei, usque laete luteo-fusci. Excipulum externum e textura globulosa usque globuloso-angularis, excipulum parte inferiore sub hypothecio e textura globuloso-angularis vel usque textura angularis-subintricata. Paraphyses filiformes, apice sensim vel valde incrassatae, clavatae, vel usque capitatae et lobato-furcatae, pigmento luteo vel luteo-aurantiaco, carotenoideo donatae. Asci cylindracei, octospori, non amylloidei. Ascosporae ellipsoideae, eguttulatae, hyalinae, perisporio separabili,longitudinaliter striato cum costis cyanophilis anastomosantibus.
Habitat: Ad excrementa.
Typus: *Peziza granulata* Bulliard, Herb.Fr.t.438,fig.3,1970;
ex Fries, Syst.mycol. 2/1:67,1822.
Species: *Coprobia granulata* (Bull.)Boud., *C. sordida* J.Mor. *C. flava* (Karst.)Thind et Kaushal, *C. striata* (Thind,Cash et Singh) Waraith, *C. theleboloides* (Alb. et Schw.) J.Mor., *C. crassistriata* J.Mor., *C. humana* (Velen.) Svr.

The basic features which distinguishe *Coprobia* from *Cheilymenia* are: the absence of hairs of the external surface of apothecia which are with only rare hyphal outgrowths near the base, or, presence of only superficial hairs or hyphae, which originate from the excipular cells of the ectal layer, and, the perisporial cyanophilic rib-like longitudinal striation of ascospores.
The differences in excipular structure, considered not important features by me, were discussed earlier (J.Moravec 1984). In *Coprobia*, the differences are slight in fact. Medullary excipulum is not differentiated, or is only purely differentiated from the ectal layer, and, in no species is formed of typical textura intricata, though the cells may be gradding to some hyphal elements (even in species commonly regarded as species with "homogenous" excipulum).
In my opinion, *Cheilymenia lemuriensis* Heim ex Le Gal (1953) is a species of *Coprobia* too, but I have not yet examined the type.

467	line	23	for	Tricothelium	read	Trichothelium
489	line	10	for	C. hyalochaeta	read	Cheilymenia hyalochaeta
496	line	36	for	*P.*	read	*Parmotrema*
514	line	45	for	*C.*	read	*Corynesporopsis*
515	line	10	for	*C.*	read	*Corynesporopsis*
		7	for	Dicheirina	read	Dicheirinia

The genus Cheilymenia is distinguished by the presence of rooting apothecial hairs originating deeply within the excipular tissue, and, by the ascospores which are without the longitudinal rib-like striation of the perisporium. This genus is very close to Scutellinia (Cooke)Lamb.emend Le Gal and deserves further study.

Cheilymenia raripila and related species are not congeneric, in this sense, with Cheilymenia nor Coprobia. A paper on their taxonomy, including results of reexaminations of the type collections of C. hyalochaeta and C. notabilispora will be published in near future.

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NEW SPECIES IN THE LICHEN FAMILY PARMELIACEAE (ASCOMYCOTINA) FROM THE SOUTHERN HEMISPHERE

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ABSTRACT : The species, *Canoparmelia macrospora* Elix & Johnston, *Canoparmelia norpruinata* Elix & Johnston, *Parmelia protosignifera* Elix & Johnston, *Parmeliopsis evernica* Elix & Johnston, *Parmotrema austrocetratum* Elix & Johnston, *Parmotrema convolutum* Elix & Johnston, *Parmotrema judithae* Elix & Johnston, *Parmotrema ochrocrinitum* Elix & Johnston, *Punctelia nebulata* Elix & Johnston, *Punctelia novozelandica* Elix & Johnston, *Relicina subnigra* Elix & Johnston, *Relicina terricrocodila* Elix & Johnston, *Relicinopsis stevensii* Elix & Johnston, *Xanthoparmelia callifolioides* Adler, Elix & Johnston, *Xanthoparmelia nigraoleosa* Elix & Johnston, and *Xanthoparmelia prodomokosii* Hale, Elix & Johnston are described as new. Apart from the Argentinian species *X. callifolioides* and the New Zealand endemic, *P. novozelandica*, the remaining species occur in Australia. *Parmotrema austrocetratum* and *P. protosignifera* also occur in New Zealand and *Parmotrema austrocetratum* on Norfolk Island. The new combination *Punctelia subflava* (Taylor) Elix & Johnston is made and *X. brunnthaleri* (Stein. & Zahlbr.) Hale and *X. subpigmentosa* Hale are reported for the first time from Australia.

Introduction

As a result of further study of the lichen family Parmeliaceae in the Southern Hemisphere, and particularly in Australasia (Adler & Elix 1987; Elix & Adler 1987; Elix & Johnston 1986, 1987a, 1987b, 1987c; Elix, Johnston & Armstrong 1986; Nash & Elix 1987; Nash, Elix & Johnston 1987a, 1987b), we are describing 18 new species. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson, Culberson & Johnson 1981; Culberson & Johnson 1982), high performance liquid chromatography (Lumbsch & Elix 1985) and comparison with authentic samples.

Canoparmelia macrospora Elix & Johnston, sp. nov. Figure 1

Species cum thallo ut in *Canoparmelia pruinata* sed ab hac specie subtus pallida , sporis majoribus et scabrosinum 4,4'-diacetatum continente differt.

Type. Australia. Western Australia. On bark, near Kalgoorlie, *M. F. Day*, viii.1982; CBG-holotype.

Thallus foliose, corticolous, closely adnate, mineral to lead-grey, to 5 cm in diameter; *lobes* subirregular, crowded and imbricate, 1.0-2.0 mm wide, eciliate. *Upper surface* smooth and shiny at the apices, plane or weakly foveolate at first, becoming

wrinkled and rugose with age, ± weakly maculate around the submarginal foveolae, lacking soredia and isidia but usually with granular white pruina towards the apices; medulla buff. *Lower surface* ivory to pale brown, moderately to densely rhizinate, rhizines concolorous with the lower surface, simple or tufted at the tips. *Apothecia* common, sessile, to 2 mm in diameter, disc concave at first but becoming flattened with age, dark brown, epruinose; margin thin, entire, smooth, thalline exciple densely pruinose; asci 8-spored, spores simple, colourless, oblong, straight or commonly curved, 16-20 x 5-6 μm. *Pycnidia* numerous, punctiform or slightly emergent, black; conidia commonly curved, cylindrical to weakly fusiform, 9-11 x 1 μm.
Chemistry. Thallus K+ yellow, medulla K-, C-, KC-, P- ; containing atranorin, chloroatranorin, scabrosin 4,4'-diacetate.

This rare species closely resembles smaller specimens of *Canoparmelia pruinata* (Müll. Arg.) Elix & Johnston; both species have weakly foveolate, ± maculate apical lobes which are densely pruinose, pruinose amphithecia, and conidia which are commonly curved and cylindrical to weakly fusiform. However *C. macrospora* has a pale ivory lower surface and large (16-20 x 5-6 μm), oblong (± curved) spores whereas *C. pruinata* has a black lower surface and small (8-9 x 5-5.5 μm), ellipsoid spores. Moreover these two species can readily be distinguished chemically since *C. pruinata* contains medullary lecanoric acid (C+ red) while *C. macrospora* contains scabrosin 4,4'-diacetate. At present this new species is only known from the southern inland of Western Australia.

Specimen Examined
WESTERN AUSTRALIA. On base of *Acacia* in open scrubland with *Acacia* and *Eucalyptus* dominant, 4 km east of Bulla Bulling, 31°01'S, 120°53'E, *J. A. Elix 21728 & M. V. Sargent*, 20.viii.1987 (ANUC).

Canoparmelia norpruinata Elix & Johnston, sp.nov. Figure 2

Thallus adnatus vel appressus, corticola, pallide cinereus, 5-10 cm latus; lobis subirregularibus, 2-5 mm latis, marginibus eciliatis; superne nitidus, rugulosus, pruinosus ad apices; subtus niger, modice rhizinosus, rhizinis nigris, simplicibus. Apothecia numerosa, sessilia vel substipitata, disco concavo demum undulato et distorto, 3-7(-17) mm diametro; sporae 8, 9-11 x 6-8 μm. Atranorinum, chloroatranorinum et acidum lecanoricum continens.

Type. Australia. New South Wales. On trunk of old *Banksia* in pasture, along the Steeple Flat road, 4 km east of Nimmitabel, 1095 m, J. A. Elix *1626*, 20.i.1976; CBG-holotype, MEL-isotype.

Thallus foliose, corticolous, closely appressed to the substrate, pale grey to grey-green, 5-10 cm in diameter; *lobes* subirregular, crowded and imbricate, 2.0-5.0(-7.0) mm wide, ± subascending, apices rotund. *Upper surface* shiny at first, becoming dull and markedly rugose with age, emaculate, lacking soredia and isidia but usually with granular white pruina towards the apices; medulla white. *Lower surface* black to brown-black, with a pale brown to ivory marginal zone, moderately to sparsely rhizinate, rhizines often more prominent subapically, simple to tufted or fasciculate, concolorous with the lower surface. *Apothecia* common, sessile to substipitate, to 3-7(-17) mm in diameter, disc concave at first but becoming undulate-distorted with age and developing elevated, concentric zones from the centre, red-brown to dark brown-black, epruinose; margin thick, entire, inrolled, thalline exciple smooth, shining, often pruinose, asci 8-spored, spores colourless, ellipsoid, 9-11 x 6-8 μm. *Pycnidia* numerous, commonly elevated, crateriform, black, conidia straight, weakly fusiform to bifusiform, 7-8 x 1 μm.
Chemistry. Thallus K+ yellow, medulla K-, C+ red, P- ; containing atranorin, chloroatranorin, lecanoric acid and rarely traces of orsellinic acid.

Previously this species has been confused with *Parmelina stevensiana* Elix & Johnston (Elix & Johnston 1986), as these two species have a similar growth habit and contain lecanoric acid. However *Canoparmelia norpruinata* has a more robust thallus, with broader (2-5 mm), irregular, thicker lobes, larger (to 17 mm), gyrose-contorted apothecia, and lacks cilia even in the lobe axils. This new species has a restricted distibution in the mountainous areas of south-eastern Australia and Tasmania. *P. stevensiana* occurs in a much wider area of southern Australia, Tasmania and New Zealand and is distinguished by the smaller thalli (2-4 mm), with thinner, narrower (1-2 mm), sublinear-elongate lobes, smaller (to 4 mm) concave apothecia, and the presence of cilia (albeit often sparse) in the lobe axils. This new species also resembles *Canoparmelia pruinata* (Müll.Arg.) Elix & Johnston, from South Australia and Western Australia. The latter species differs from *C. norpruinata* in having concave to flat apothecia with a densely granular-pruinose disc and curved conidia. By contrast the apothecia of *C. norpruinata* become gyrose-contorted, with an epruinose disc and straight conidia.

C. norpruinata is a scattered species on the branches of trees and shrubs (and rarely on rocks) in the cooler, higher rainfall, upland areas of southern Australia (NSW, ACT, Vic, Tas.).

Specimens Examined

NEW SOUTH WALES. On dead twigs of *Acacia* in pasture, 46 km south of Cooma along the Snowy Mountains Hwy., 1150 m, *J. A. Elix 5443*, 23.xi.1978 (ANUC); on shrubs in open *Eucalyptus* forest, Morton National Park, 8 km NE of Nerriga, 35°07'S, 150°08'E, 750 m, *J. A. Elix 11426 & J. Johnston,* 6.x.1983 (ANUC).

AUSTRALIAN CAPITAL TERRITORY. On bark of *Pinus radiata*, on dry ridge, Mulligans Flat, 670 m, *J. A. Elix 1435,* 10.xii.1975 (ANUC); on granite rocks in dry sclerophyll forest, along Kangaroo Creek near Corin Dam, 1000 m, *J. A. Elix 2925,* 10.iii.1977 (ANUC); on *Leptospermum* shrubs, summit of Mt. Aggie, Brindabella Range, 43 km WSW of Canberra, 1490 m, *J. A. Elix 5824*, 28.iii.1979, *J. A. Elix 10256,* 29.v.1982 (ANUC); at base of *Eucalyptus* in open woodland, Long Flat, Clear Range, 65 km S of Canberra, 1350 m, *J. A. Elix 9020,* 1.x.1980 (ANUC).

VICTORIA. On *Leptospermum* in coastal scrub, 0.5 km E of Marlo, 6 m, *J. A. Elix 5203,* 20.xi.1978 (ANUC).

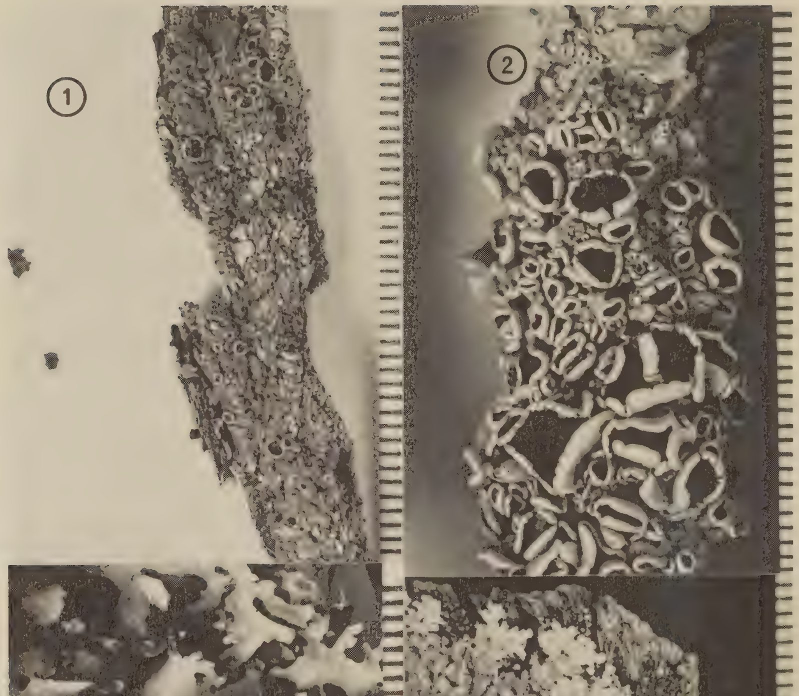
TASMANIA. On *Pinus radiata* in park, Ouse, 88 km NW of Hobart, *J. A. Elix 5621,* 18.i.1979 (ANUC); on *Kunzea ambigua*, Myrmidon Bay, 800 m SW of Squashway, Dover Island, Kents Group, Bass Strait, 40 m, *J. S. Whinray,* 13.xii.1970 (MEL 1012678).

Parmelia protosignifera Elix & Johnston, sp.nov. Figure 3

Species cum thallo ut in *Parmelia signifera* sed ab hac specie acidum protocetraricum continente differt.

Type. Australia. New South Wales. On sheltered granite rock ledges in *Eucalyptus* woodland, eastern slopes of Tinderry Pic, 12 km E of Michelago, 1340 m, *J. A. Elix 4051*, 8.xii.1977; CBG-holotype; MEL-isotype.

Thallus foliose, saxicolous, loosely adnate, pale mineral grey or becoming brownish and blackening with age, to 15 cm in diameter; *lobes* sublinear, crowded and imbricate, 2.0-6.0(-10.0) mm wide, apices rotund, secondary lobes often building the thallus into a thick, pulvinate mat, ± lobulate with age in the centre of the thallus, lobules marginal, suberect. *Upper surface* shiny at the apices, becoming dull, plane to rugose or foveolate, becoming extensively cracked with age, with pseudocyphellae but lacking soredia and isidia, *pseudocyphellae* effigurate, dense, often forming a reticulate pattern, appearing raised; medulla white. *Lower surface* jet black but brown at the margins, densely rhizinate to the margins, rhizines simple, dichotomous or sparingly squarrosely branched, black. *Apothecia* common, sessile to substipitate, to 8 mm in diameter, disc



Figures 1-4. New species of Parmeliaceae: 1, *Canoparmelia macrospora* (holotype in CBG); 2, *Canoparmelia norpruinata* (*J. A. Elix 5443* in ANUC); 3, *Parmelia protosignifera* (holotype in CBG); 4, *Parmeliopsis evernica* (holotype in CBG). Scale in mm.

rugulose, concave at first but becoming undulate-distorted with age, pale brown to dark brown; margin thin, crenulate, deeply incised and lacerate, amphithecium pseudocyphellate; asci 8-spored, spores colourless, ellipsoid to broad ellipsoid, 11-15 x 8-9 µm. *Pycnidia* minute, punctiform, conidia bifusiform, 6-7 x 1 µm.
Chemistry. Thallus K+ yellow; medulla K+ pale yellow-brown, C-, P+ red-orange; containing atranorin, chloroatranorin, protocetraric acid.

Previously this new species has been incorporated with *Parmelia signifera* Nyl. since these two species have comparable morphology and can only reliably be distinguished by chemical means. Thus *P. signifera* contains medullary salazinic acid (K+ yellow-dark red) while *P. protosignifera* contains protocetraric acid (K+ pale yellow-brown). However since these two species have markedly different distribution patterns (*P. protosignifera* is much rarer and has a more southerly distribution in both Australia and New Zealand) they are considered distinct species (Elix 1982). *P. protosignifera* is a scattered species on rocks in subalpine areas of south-eastern Australia and the south island of New Zealand.

Specimens Examined
VICTORIA. On exposed sandstone, 1 km from summit of Mt. William, Grampian Mts., *M. E. Hale 58,374*, 13.i.1982 (US).
NEW ZEALAND. South Island. On rock, Cave Hill, near Dunedin, *J. S. Thomson* (Z. A. 241) (CHR).

Parmeliopsis evernica Elix & Johnston, sp. nov. Figure 4

Species cum thallo ut in *Parmeliopsis aleurites* sed ab hac specie acidum evernicum continente differt.
Type. Australia. New South Wales. On dead stump in open *Eucalyptus* woodland, Goorooyarroo Reserve, 15 km north of Queanbeyan along the Sutton road, 35°14'S, 149°15'E, 740 m, *J. A. Elix 11405*, 11.x.1983; CBG-holotype.

Thallus foliose, corticolous, orbicular, adnate, pale ash-grey, to 5 cm in diameter; *lobes* sublinear, narrow, 0.8-1.5 mm wide, irregularly branched. *Upper surface* dull, plane or weakly foveolate, slightly arachnoid under strong magnification (x 50), emaculate, with short granulose *isidia*, coalescing with age to form to form a dense mass of *soredia* in the centre of the thallus; medulla white. *Lower surface* ivory to pale brown, moderately to densely rhizinate, rhizines concolorous with the lower surface, simple or tufted at the tips. Apothecia not seen. *Pycnidia* small, black, globose, emergent at or near the margins, to 0.1 mm in diameter; conidia immature.
Chemistry. Thallus K+ yellow; medulla K-, C-, KC+ red, P- ; containing atranorin, chloroatranorin, evernic acid.

Morphologically this new species resembles some specimens of *Parmeliopsis aleurites* (Ach.) Nyl. em. Lettau where the initial short, cylindrical isidia degenerate with age to form a dense, coarsely-granular sorediate mass in the centre of the thallus. However the development of granulose sorediate-isidia is much more extensive in *P. evernica* than it is in Australian specimens of *P. aleurites*, which often exhibits corticate, cylindrical isidia even when aged. Furthermore these two species can be readily distinguished chemically since *P. aleurites* contains medullary thamnolic acid (K+ yellow) while *P. evernica* contains evernic acid. This new species is known only from the type location.

Parmotrema austrocetratum Elix & Johnston, sp. nov. Figure 5

Species cum thallo ut in *Parmotrema cetratum* sed ab hac specie superne dactylata, aetate areolas magnas formans, areolis demum valde concavis plus minusve conferruminatis et porcas formantibus vel disruptis et areis erosis albidis differt.

Type. New Zealand. North Island. On tree trunk in remnant forest, Burgess Park, New Plymouth, 60 m, *J. A. Elix 4645*, 7.v.1980; CHR-holotype, CBG-isotype.

Thallus corticolous or saxicolous, loosely attached, light mineral-grey, 6-12 cm in diameter. *Lobes* rotund, imbricate or not, 10-20(-30) mm wide, apices often laciniate, the lacinae flat or convex, 0.5-1.5 mm wide, 1-5(-8) mm long, lobes moderately ciliate, the cilia 0.2-1.0(-1.5) mm long, simple or sparingly branched. *Upper surface* white-reticulate at first but becoming conspicuously cracked to the margin, developing raised closed dactyls, dactyls ± curved, laminal, ultimately becoming fused with the formation of laminal ridges, the older parts of the thallus eventually becoming cracked-areolate and the areolae flaking off and exposing the white medulla in eroded areas; lacking soredia and isidia. *Lower surface* black with a bare, brown marginal zone 1-2 mm wide, moderately to densely rhizinate, rhizines simple or sparsely branched, slender, black. *Apothecia* rare, stipitate, to 10 mm in diameter, disc perforate, pale tan, concave at first then concave-distorted, margin eciliate, thin, ± stellate-cracked, asci 8-spored, spores colourless, ellipsoid, 12-16 x 8-9 µm. *Pycnidia* scattered, punctiform, black, conidia filiform, 9-16 x 1 µm.
Chemistry. Cortex K+ yellow, medulla K+ yellow becoming deep red, C-, P+ red-orange; containing atranorin, chloroatranorin, salazinic acid (major), consalazinic acid (minor), protocetraric acid (± trace).

This new species seems to be related to *Parmotrema cetratum* (Ach.) Choisy, which also contains salazinic acid and has a reticulate-cracked upper cortex and perforate apothecia. However *P. austrocetratum* is distinguished by the development of laminal dactyls, by the upper cortex becoming much more extensively and deeply cracked and areolate, in being rarely fertile, more loosely adnate, and by having a distinct bare brown marginal zone on the underside of the lobes. By comparison *P. cetratum* is usually copiously fertile, adnate to the substrate, edactylate, is only weakly reticulate and never cracked-areolate, while the lower surface is black and rhizinate to the margins. In particular, *P. cetratum* does not exhibit distinct laminal dactyls (ridges), nor the flaking off of the areolae, which are very characteristic features of *P. austrocetratum*. *Parmelia (Parmotrema) hawaiiensis* H. Magnusson and *P. (Parmotrema) ruminata* Zahlbr. also appear to be related to *P. austrocetratum*. However *P. hawaiiensis* lacks apical laciniae and although the upper cortex becomes cracked and areolate with the areolae ultimately peeling off and exposing the lower cortex, they do not develop from raised dactyls. *P. ruminata* on the other hand lacks cilia and could well be the eciliate counterpart of *P. austrocetratum*. *P. austrocetratum* is a widespread species on rocks and trees in coastal and hinterland areas along the subtropical and tropical east coast of Australia and the north island of New Zealand.

Specimens Examined
QUEENSLAND. On rain forest trees, Lake Eacham National Park, 750 m, *J. A. Elix 2628,* 27.viii.1976 (ANUC); on felled tree in rainforest, Kirrima State Forest, Cardwell Range, 24 km WNW of Cardwell, 18°12'S, 145°48'E, 750 m, *J. A. Elix 15714 & H. Streimann,* 20.vi.1984 (ANUC); on sapling along margin of regrowth rainforest, Great Dividing Range, Mt. Baldy, 4 km SW of Atherton, 17°17'S, 145°27'E, 1080 m, *J. A. Elix 16307 & H. Streimann,* 25.vi.1984 (ANUC); on rocks in *Eucalyptus grandis* woodland, Hugh Nelson Range, along Plath Road, 15 km S of Atherton, 17°25'S, 145°26'E, 1080 m, *J. A. Elix 16328 & H. Streimann,* 25.vi.1984 (ANUC); on *Flindersia* in open rainforest, Mt. Windsor Tableland, 45 km NW of Mossman, 16°15'S, 145°01'E, 1200 m, *J. A. Elix 16440 & H. Streimann,* 26.vi.1984 (ANUC); on remnant trees, along the Tully Falls Road, 8 km SE of Ravenshoe, 17°40'S, 145°31'E, 940 m, *J. A. Elix 16803 & H. Streimann,* 29.vi.1984 (ANUC); on trunk of roadside tree, 1 km S of Maalan, 11 km E of Ravenshoe, 17°36'S, 145°38'E, 980 m, *J. A. Elix 17104 & H. Streimann,* 2.vii.1984 (ANUC); on canopy of *Argyrodendron* in rainforest,

489	line	10	for	C. hyalochaeta	read	Cheilymenia hyalochaeta
496	line	36	for	*P.*	read	*Parmotrema*
514	line	45	for	*C.*	read	*Corynesporopsis*
[illegible]	[illegible]	[illegible]	for	[illegible]	read	*Corynesporopsis*

Crediton State Forest, 20 km SSW of Finch Hatton, 21°19'S, 148°33'E, 840 m, *J. A. Elix 21021 & H. Streimann,* 1.vii.1986 (ANUC).
NEW SOUTH WALES. On mossy rocks in rainforest, Jamison Valley below Katoomba Falls, 850m, *J. A. Elix 3244,* 25.iv.1977 (MEL, ANUC); on sandstone rocks in dry sclerophyll forest, near Mt. Bouddi, Bouddi National Park, *J. A. Elix 4645*, *J. A. Elix 4676*, 7.v.1978 (ANUC); on sandstone rocks, Tianjara Falls, 33 km NNW of Ulladulla, *J. A. Elix 5945a, J. A. Elix 5963*, 21.vi.1979 (ANUC); on remnant rainforest trees, 4 km E of Robertson, 730 m, *J. A. Elix 8892,* 17.ix.1980 (ANUC).
SOUTH AUSTRALIA. On rocks in ravine, Alligator Gorge, 9 km S of Wilmington, Mt. Remarkable National Park, Flinders Ranges, 32°45'S, 138°03'E, 400 m, *J. A. Elix 17779 & L. H. Elix,* 27.x.1984 (ANUC).
NEW ZEALAND. North Island. North Auckland: on fallen twigs in remnant forest, Whangarei Falls, Whangarei, 60 m, *J. A. Elix 8029,* 11.v.1980 (ANUC). South Auckland: on *Avicennia resinifera* in tidal swamp, Kauaeranga River estuary, Thames, *J. A. Elix 9946,* 9.i.1982 (ANUC); on rocks in open scrubland, trail to Cathedral Cove, Hahei, Coromandel Peninsula, 15 m, *J. A. Elix 9990,* 9.i.1982 (ANUC); on pohutukawa along foreshore, Orakawa Bay, Waihi Beach, *J. A. Elix 10008*, 11.i.1982 (ANUC); on pohutukawa along foreshore, Ohope Beach, Bay of Plenty, *J. A. Elix 10020*, 11.i.1982 (ANUC). Gisbourne: on rocks along the foreshore, Hicks Bay, East Cape, *J. A. Elix 10069,* 12.i.1982 (ANUC). Taranaki: on forest trees in park, Pukekura Park, New Plymouth, 30 m, *J. A. Elix 7967,* 7.v.1980 (ANUC).
NORFOLK ISLAND. On *Elaeodendron* in open woodland, Mt. Pitt Reserve, track at end of Selwyn Pine Road, 29°01'S, 167°56'30"E, 215 m, *J. A. Elix 18742 & H. Streimann,* 8.xii.1984 (ANUC).

Parmotrema convolutum Elix & Johnston, sp. nov. Figure 6

Thallus corticola ad ramos, laxe adnatus, rigidulus, albo-cinereus, 3-5 cm latus; lobis sublinearibus, convolutis, separatis, apicibus rotundatis, subdichotome lobatis, 3-5 mm latis, ciliatis; superne nitidus, convexus, emaculatus, ± lobulatus; sorediis isidiisque destitutis; subtus centrum versus niger, sparse rhizinosus, ambitu nudus, castaneus.
Type. Australia. New South Wales. Growing on *Prostanthera* sp. in wet sclerophyll forest, Great Dividing Range, 6 km east of Captains Flat, 2 km north of Parkers Gap, 35°37'S, 149°30'E, 1260 m, *J. A. Elix 10894 & J. Johnston*, 3.iii.1983; CBG-holotype.

Thallus corticolous on twigs, loosely attached, pale grey, relatively rigid, 3-5 cm in diameter. Lobes linear-elongate, markedly convolute, separate, not at all imbricate, subdichotomously divided, 3-5 mm wide, the apices rotund, ciliate, cilia simple, minute, 0.5-1.0 mm long. *Upper surface* shiny, smooth, convex, emaculate, lacking soredia and isidia but occasionally developing rotund marginal lobulae, lobules 0.5-2.0 mm wide; medulla white. *Lower surface* black with a broad, nude, chestnut brown marginal zone, moderately to sparsely rhizinate, rhizines grouped subapically, simple, short, slender, 0.5-1.0 mm long. Apothecia and pycnidia not seen.
Chemistry: Cortex K+ yellow; medulla K+ yellow, C-, P+ orange; containing atranorin, chloroatranorin, stictic acid (major), constictic acid (major), cryptostictic acid (trace), norstictic acid (trace), menegazziaic acid (trace).

This new species is distinguished by the unique morphology, with the characteristic elongated, markedly convolute, lobes, and rotund lobules. *Parmotrema lobulatum* Marcelli & Hale also is characterised by the presence of medullary stictic acid, lobules and short cilia, but this species has an entirely different growth form, with flat, crowded lobes and linear-elongate, marginal lobules. This new species appears to be very rare and at present is known only from the type locality.

Parmotrema judithae Elix & Johnston, sp. nov. Figure 7

Species cum thallo ut in *Parmotrema flaccidifolium* sed ab hac specie tenuiore et eciliata differt.
Type. Australia. Queensland. On *Callitris columellaris* in open woodland, Coochiemudlo Island, Moreton Bay, sea level, *J. A. Elix 10433*, 5.ix.1982; CBG-holotype.

Thallus corticolous, adnate to loosely adnate, coriaceous, pale mineral grey, 4-6 cm in diameter; *lobes* irregular, 4-10 mm wide, rotund at the apices, imbricate or subascending at the margins, eciliate. *Upper surface* dull, emaculate, becoming markedly rugose with age, continuous or ± cracked, sorediate; *soralia* marginal, linear along the margins to subcapitate on somewhat revolute lobes or short marginal laciniae, sometimes spreading submarginally; medulla white. *Lower surface* wrinkled, black, with a broad, brown, naked marginal zone, sparsely to moderately rhizinate, rhizines simple, short, *ca.*0.1-0.2 mm long, slender. *Apothecia* rare, adnate, concave, to 3 mm in diameter, disc dark brown, imperforate, margin thick, eciliate, margin and amphithecium sorediate; spores ellipsoid to reniform, 17-21 x 8-10 µm. *Pycnidia* rare, punctiform, no mature conidia seen.
Chemistry: Cortex K+ yellow; medulla K-, C-, P+ brick-red; containing atranorin, chloroatranorin, fumarprotocetraric acid (minor), succinprotocetraric acid (major), protocetraric acid (trace), protolichesterinic acid (± minor), unknown fatty acids (± trace).

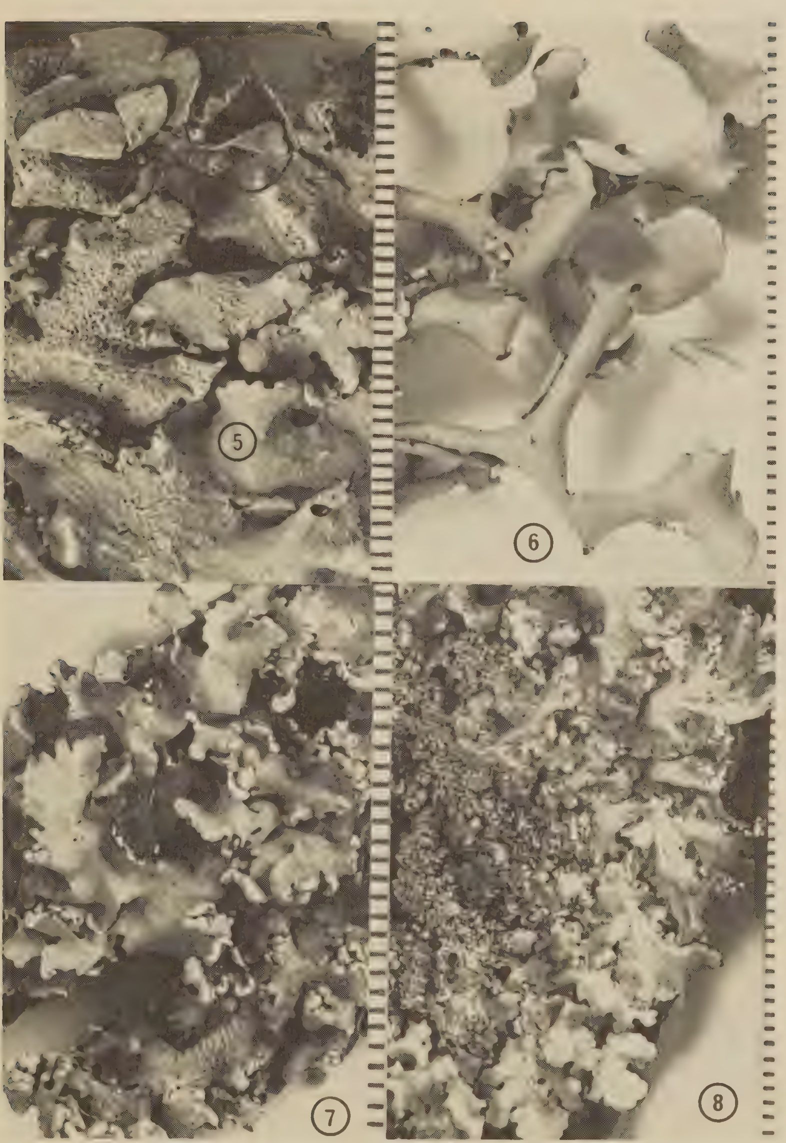
The presence of the marginal soralia and the medullary succinprotocetraric acid and fumarprotocetraric acid in this new species immediately bring the Papua New Guinean species, *P. flaccidifolium* (Kurok.) Streim., to mind. However the latter has dense, long and conspicuous cilia and a thin, papery thallus, whereas *P. judithae* is eciliate and has a coriaceous thallus. Morphologically this new species resembles some sparingly ciliate forms of the common species, *Parmotrema dilatatum* (Vain.) Hale, but the latter can be distinguished by the scattered cilia, the yellow tinge of the upper surface (due to traces of usnic acid present) and the medullary chemistry (protocetraric acid and echinocarpic acid). At present this species is known from several coastal and hinterland localities in Queensland. This species is named in honour of the Australian bryologist, Judith A. Curnow of the Herbarium, Australian National Botanic Gardens (CBG), who brought this species to our attention.

Specimens Examined
QUEENSLAND. On *Araucaria cunninghamii* in rainforest, Pine Circle Track, Noosa Heads National Park, 20 m, *J. A. Elix 10376*, 31.viii.1982 (ANUC); on Euphorbiaceae in dry sclerophyll forest, 19°26'S, 146°24'E, 350 m, *J. A. Elix 20442 & H. Streimann, J. A. Elix 20443 & J. A. Curnow,* 20.vi.1986 (ANUC); on volcanic rocks in disturbed *Eucalyptus* woodland, Mt. Stuart, 10 km SSW of Townsville, 19°21'S, 146°47'E, *J. A. Elix 21232 & H. Streimann,* 3.vii.1986 (ANUC); type locality, *J. Johnston 1349*, 30.viii.1984 (ANUC).

Parmotrema ochrocrinitum Elix and Johnston, sp. nov. Figure 8

Species cum thallo ut in *Parmotrema crinitum* sed ab hac specie medulla inferiore pigmentum ochraceum et euplectinum continente differt.
Typus. Australia. Victoria. On *Banksia integrifolia*, Cape Conran, 18 km east of Marlo, East Gippsland, sea level, *J. A. Elix 5293*, 21.xi.1978; CBG-holotype.

Thallus corticolous or saxicolous, coriaceous, adnate, pale mineral grey to grey-green, 5-6 cm in diameter. *Lobes* subirregular, crenate or irregularly incised, imbricate, 2-5 mm wide, the margin ciliate, cilia simple or branched, 0.5-3.0 mm long. *Upper surface* plane, emaculate, smooth to rugose with age, cortex fragile, isidiate; *isidia* laminal and marginal, short-cylindrical at first, ± becoming coralloid, granulose or



Figures 5-8. New species of Parmeliaceae: 5, *Parmotrema austrocetratum* (holotype in CHR); 6, *Parmotrema convolutum* (holotype in CBG); 7, *Parmotrema judithae* (holotype in CBG); 8, *Parmotrema ochrocrinitum* (holotype in CBG). Scale in mm

occasionally dissolving into soredia, often ciliate at the apices; medulla white in the upper part but pigmented yellow-orange towards the lower cortex. *Lower surface* black, with a narrow brown, naked marginal zone, densely rhizinate, rhizines slender, to 1.0 mm long. Apothecia and pycnidia not seen.
Chemistry: Cortex K+ yellow; upper medulla K+ yellow, C-, P+ orange, lower medulla K+ violet. Containing atranorin, chloroatranorin, stictic acid (major), constictic acid (minor), euplectin (minor), cryptostictic acid (trace), norstictic acid (trace), menegazziaic acid (±trace), connorstictic acid (± trace).

Morphologically and chemically this new species closely resembles the common *Parmotrema crinitum* (Ach.) Choisy, but can be readily distinguished by the heavily yellow-orange pigmented lower medulla. This region contains the anthraquinone pigment euplectin, first recognised in *Flavoparmelia euplecta* (Stirt.) Hale, but of indeterminate structure. *P. ochrocrinitum* has a much more restricted distribution than the cosmopolitan *P. crinitum*, at present being known only from southern and eastern Australia and possibly Taiwan (M. E. Hale, in litt.).

Specimens Examined
QUEENSLAND. On dead wood, trail through rainforest, Python Rock Track, Lamington National Park, S of Brisbane, *M. E. Hale 68883*, 8.viii.1983 (US); over mosses, debris and stones, large road cutting with a southerly aspect in wet sclerophyll forest, junction of Mt. Nebo and Samford PEI roads, Mt. Glorious, 27°21'S, 152°46'E, 520 m, *J. Johnston 1412*, 28.viii.1984 (ANUC).
VICTORIA. On coastal granite rocks, type locality, *J. A. Elix 5283*; on shrub in coastal scrub, type locality, *J. A. Elix 5309*, 21.xi.1978 (ANUC).

Punctelia nebulata Elix & Johnston, sp.nov. Figure 9

Species cum thallo ut in *Punctelia subalbicans* sed ab hac specie acidum lecanoricum deficiente differt.
Type. Australia. New South Wales. On roadside *Callitris columellaris*, 10 km north of Gilgandra along Highway 39, 280 m, *J. A. Elix-2320*, 16.viii.1976; CBG-holotype, MEL-isotype.

Thallus foliose, corticolous, adnate, pale grey to mineral grey or blackening with age, to 8 cm in diameter; *lobes* subirregular, crowded and imbricate, 2.0-4.0 mm wide, apices rotund, crenulate. *Upper surface* shiny at first, becoming dull, rugose towards the centre, pseudocyphellate; *pseudocyphellae* punctiform, confined to the lobe margins and the receptacle, lacking soredia and isidia but usually with granular white pruina towards the apices; medulla white. *Lower surface* ivory to pale brown, moderately rhizinate, rhizines simple to fasciculate or agglutinated, concolorous with the lower surface. *Apothecia* common, pedicellate, crowded in the central part of the thallus, to 10 mm in diameter, disc concave at first but becoming undulate and more or less flat with age, ± irregularly cracked, pale brown to dark brown; margin thin, crenulate, persistent, margin and amphithecium rugose-areolate, pseudocyphellate; asci 8-spored, spores colourless, subspherical to ellipsoid, 10-13 x 7-9 μm. *Pycnidia* numerous, subspherical, immersed in the thallus, conidia elongated, filiform, 9-11 x 1 μm.
Chemistry. Thallus K+ yellow; medulla K-, C-, KC-, P-; containing atranorin, chloroatranorin.

Previously this new species has been confused with *Punctelia subalbicans* (Stirt.) Galloway & Elix as these two species have comparable morphology and can only reliably be distinguished by chemical means. Thus *P. subalbicans* contains medullary lecanoric acid (C+ red) while *P. nebulata* lacks medullary substances.

P. nebulata is a scattered species growing on *Callitris* trees in the semi-arid, inland areas of southern Australia (NSW, SA).

Specimens Examined
NEW SOUTH WALES. On *Callitris columellaris* in *Callitris* woodland, along the Sturt Highway, 30 km west of Narrandera, *J. A. Elix 3655*, 27.viii.1977 (ANUC).
SOUTH AUSTRALIA. on *Callitris columellaris* in *Callitris* woodland, Flinders Ranges, Wilpena Chalet, 31°32'S, 138°36'E, 400 m, *J. A. Elix 17866 & L. H. Elix*, 29.x.1984 (ANUC); on *Callitris columellaris* in *Callitris* woodland, 4 km N of Bunyeroo Gorge, Flinders Ranges, 17 km NW of Wilpena, 31°24'S, 138°34'E, 400 m, *J. A. Elix 17908 & L. H. Elix*, 29.x.1984 (ANUC).

Punctelia novozelandica Elix & Johnston, sp.nov. Figure 10

Species cum thallo ut in *Punctelia subflava* sed ab hac specie subtus nigricante differt. *Type*. New Zealand. South Island. Canterbury; on moist rock ledges in remnant forest, Mitchells Track, Port Hills, Banks Peninsula, 420 m, *J. A. Elix 7809*, 17.iv.1980; CHR-holotype.

Thallus foliose, corticolous or saxicolous, adnate to loosely adnate, pale ash grey to brownish grey, to 10 cm in diameter; *lobes* irregular, crowded and imbricate, 2.0-4.0 mm wide, rotund at the apices, margins crenulate. *Upper surface* shiny, ± becoming white-maculate, slightly ridged, rugulose or weakly foveolate, pseudocyphellate; *pseudocyphellae* punctiform, confined to the receptacle, very rarely laminal, lacking soredia but with lobulae and isidia, *lobulae* marginal at first, developing terete isidia from the margins, *isidia*, cylindrical to slightly flattened, simple or becoming coralloid, isidia and lobulae becoming dense and spreading laminally over older lobes; medulla white. *Lower surface* black in the centre but with a paler, brown marginal zone, sparsely to moderately rhizinate, rhizines simple to fasciculate or tufted, concolorous with the lower surface. *Apothecia* rare, subpedicellate, crowded in the central part of the thallus, to 12 mm in diameter, disc irregularly concave at first but becoming undulate-distorted and ± stellate-cracked with age, red-brown to dark brown; margin thin, persistent, isidiate; amphithecium rugulose, pseudocyphellate, densely isidiate; asci 8-spored, spores colourless, ellipsoid, 11-14 x 7-8 µm. *Pycnidia* scattered, subapical, immersed in the thallus, conidia, filiform, 9-10 x 1.5 µm.
Chemistry. Thallus K-; medulla K-, C+ red, P- ; containing atranorin (trace), chloroatranorin (trace), lecanoric acid (major), orsellinic acid (± trace).

This new species closely resembles *Punctelia subflava* (Taylor) Elix & Johnston since these two species have comparable thalli, produce cylindrical to sublobulate isidia on the upper surface and have identical chemistry. However these two species are readily distinguished by the colour of the lower surface: it being black in *P. novozelandica* but ivory to pale tan in *P. subflava*. *P. novozelandica* is a scattered species on tree branches and rocks in the cool temperate Podocarp forests of both islands of New Zealand.

Specimens Examined
NEW ZEALAND. North Island. Wellington: on fallen branches in mixed Podocarp forest, Tongariro National Park, Mangawhero Forest Walk, Ohakune, 39°20'S, 175°31'E, 650 m, *J. A. Elix 18917, 18925,* 14.i.1985 (ANUC).

Punctelia subflava (Taylor) Elix & Johnston, comb.nov.

Basionym: *Parmelia subflava* Taylor, *Hook. Lond. J. Bot.*, **6** : 147 (1847).

Holotype: Van Diemen's Land (Tasmania). *Mr. Borrer*'s Herb. FH!

Previously this species has been synonymized with *Punctelia rudecta* (Ach.) Krog

(Filson 1982, Galloway & Elix 1983, Galloway 1985, Krog 1982), a species not found in Australasia. These two species have identical chemistry and bear laminal isidia on the upper surface of the lobes, but differ in a number of important morphological characters. *P. rudecta* has a thick, coriaceous thallus and more or less smooth marginal lobes while *P. subflava* has a much thinner, fragile thallus and the marginal lobes are usually foveolate. These species also differ in the nature and distribution of the pseudocyphellae. The pseudocyphellae are prominent and laminal in *P. rudecta* (dense on the marginal lobes) and often become elongated, while in *P. subflava* they are relatively sparse, occur on the margins and the amphithecium (and only rarely become laminal), and are punctiform. The nature of the isidia can also be used to distiguish these species. The isidia of *P. rudecta* are predominantly cylindrical, occasionaly interspersed with squamiform isidia, while those of *P. subflava* are always dorsiventral (rarely subterete as in the type) and usually phyllidiate-lobulate.

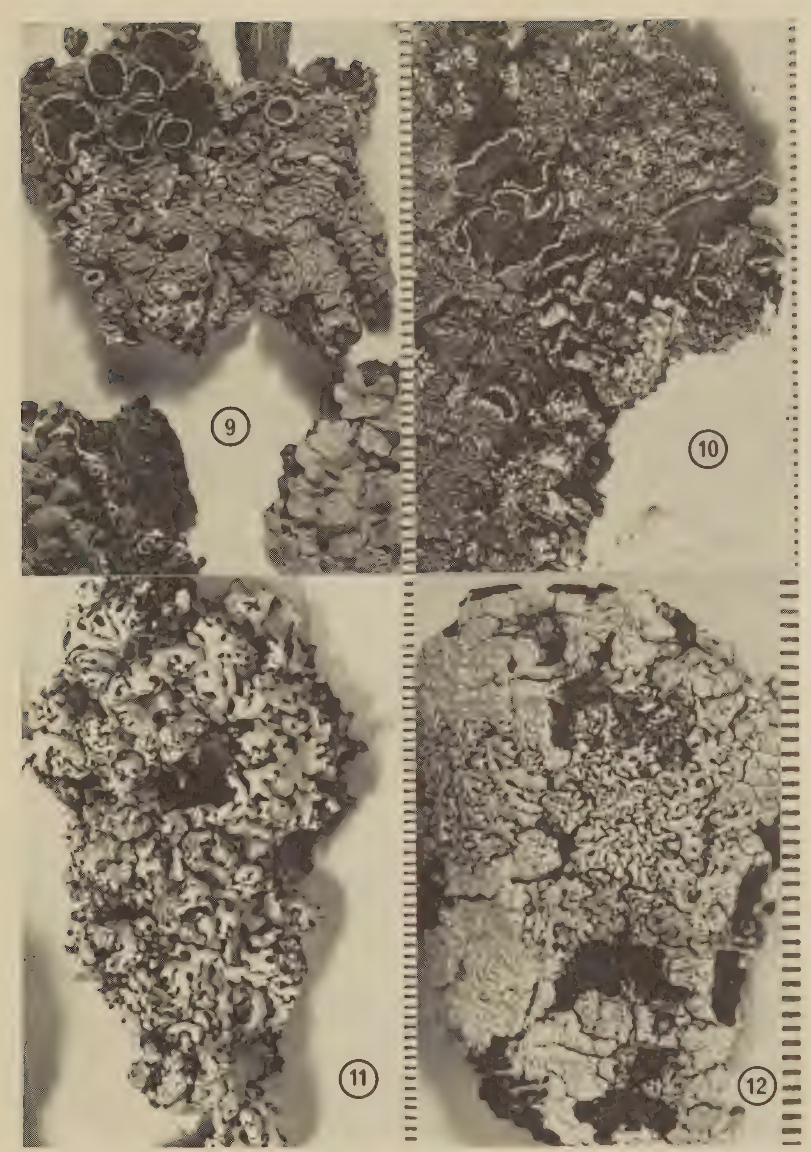
Relicina subnigra Elix & Johnston, sp. nov. Figure 11

Species cum thallo ut in *Relicina sydneyensis* sed ab hac specie colore nigro subtus differt.
Type. Australia. Australian Capital Territory. On sheltered granite rocks on cliff, along Paddys River, 1 km south of Murrays Corner, 35°23'S, 148°58'E, 550 m, *J. A. Elix 670*, 3.iii.1975 ; CBG-holotype, MEL-isotype.

Thallus foliose, saxicolous, adnate on rocks or growing over other lichens, yellow-green to yellow-brown on storage, to 8 cm in diameter; *lobes* linear-elongate, contiguous centrally to separate at the periphery, 1.0-3.0 mm wide, ± imbricate, dichotomously divided, the margins bulbate-ciliate; *cilia* dense and conspicuous, black, to 1.0 mm long, tapering to markedly inflated. *Upper surface* plane to convex, continuous, apices shiny, isidiate, *isidia* cylindrical, sparingly branched but rarely becoming coralloid; *medulla* white. *Lower surface* black to brown-black, rhizines dense, black, elongated, furcate or dichotomously branched. *Apothecia* rare, adnate, to 2 mm in diameter, disc shallowly concave then ± flat, dark brown; the exciple ecoronate, amphithecium isidiate, ± retrorsely rhizinate; asci 8-spored, spores simple, colourless, ellipsoid, 6-8 x 4-5 µm.
Chemistry. Thallus K-; medulla K+ yellow-red, C-, P+ orange; containing usnic acid, stictic acid (major), constictic acid (minor), norstictic acid (minor), cryptostictic acid (trace), menegazziaic acid (± trace).

Morphologically this new species closely resembles *Relicina sydneyensis* (Gyelnik) Hale. Both species are characterised by linear-elongate lobes with cylindrical isidia, ecoronate apothecia and the presence of the stictic acid complex in the medulla. However these two species are distinguished readily by the colour of the lower surface, the morphology of the thallus and rhizines, and their ecological requirements. *R. subnigra* has a black to brown-black lower surface, with dense, elongated, branched and entangled rhizines whereas *R. sydneyensis* has a pale tan lower surface centrally (it becomes dark brown towards the apices and the margins) and moderate, short, and predominantly simple, rhizines. Moreover the thallus of *R. subnigra* is usually considerably larger (6-8 cm *cf.* 3-6 cm) and the lobes broader (1-3 cm *cf.* 0.8-1.5 cm) than that of *R. sydneyensis*. *R. subnigra* is a saxicolous species and has a restricted distribution in the mountain and tableland areas of southern New South Wales and Victoria while *R. sydneyensis* is both corticolous and saxicolous, with a more extensive distribution, being known from temperate coastal areas in southern New South Wales to north Queensland. The latter species is known also from Japan, Taiwan, Indonesia and Papua New Guinea.

Specimens Examined
NEW SOUTH WALES. On sandstone rocks in dry sclerophyll forest, Morton National



Figures 9-12. New species of Parmeliaceae: 9, *Punctelia nebulata* (holotype in CBG); 10, *Punctelia novozelandica* (holotype in CHR); 11, *Relicina subnigra* (holotype in CBG); 12, *Relicina terricrocodila*.(holotype in MEL). Scale in mm.

Park, 8 km north-east of Nerriga, 760 m, *J. A. Elix 3082*, 30.iii.1977 (ANUC); on sandstone rocks, Peckmans Plateau, Katoomba, 980 m, *J. A. Elix 3226*, 24.iv.1977 (ANUC).
AUSTRALIAN CAPITAL TERRITORY. On rocks, Molonglo River Gorge, 15 km east of Canberra, 700 m, *J. Burmeister 139*, 27.v.1975 (CBG 058784); on sandstone rocks in moist, sheltered gully, west of summit, Black Mountain, Canberra, 730 m, *J. A. Elix 3644*, 14.viii.1977 (ANUC); on mossy granite rocks in subalpine woodland, along trail to Booroomba Rocks, 11 km south of Tharwa, 1065 m, *J. A. Elix 4034*, 16.xi.1977 (ANUC); over *Hypogymnia* and *Parmelia* lichens on mossy granite rocks, Gudgenby River Gorge, 4.5 km south of Tharwa, 35°34'S, 149°04'E, 620 m, *J. A. Elix 10907*, 10.iv.1983 (J. A. Elix: Lichenes Australasici Exsiccati, No. 50 as *Relicina sydneyensis* (Gyelnik) Hale; ANUC, CBG, MEL).
VICTORIA. On rocks, Mt. Arapiles, *R. W. Rogers 2435*, 16.viii.1981 (BRIU).

Relicina terricrocodila Elix & Johnston, sp. nov. Figure 12

Species thallo ut in *Relicina samoensis* sed ab hac specie lobis latioribus, contiguis et acidum incognitum continente differt.
Type. Australia. Queensland. On bark of *Ceriops* towards the landward fringe, large mangrove community with crocodiles, Portland Roads, Cape York Peninsula, north Queensland, *G. N. Stevens 5009*, 29.vi.1983 ; MEL-holotype; ANUC, CBG, US-isotypes.

Thallus small foliose, corticolous, tightly adnate, yellow-green, to 1.5 cm in diameter; *lobes* short, sublinear, 0.6-1.0 mm wide, crowded but sparingly imbricate, the margins bulbate-ciliate; *cilia* conspicuous, bulbae globose to tapering, cilia up to 0.4 mm long, unbranched. *Upper surface* plane, slightly shiny, emaculate, lacking soredia and isidia; medulla white. *Lower surface* jet black, sparsely rhizinate, rhizines black, simple or sparingly branched. *Apothecia* rare, adnate, to 1.0 mm in diameter, disc more or less flat, pale brown to brown, exciple apparently ecoronate (but may be immature), amphithecium retrorsely rhizinate; asci 8-spored, spores simple, colourless, broad-ellipsoid, 5.5-7 x 3.5-4.5 µm.
Chemistry. Thallus K-; medulla K+ pale yellow, C+ faint orange, KC-, P+ yellow-orange; containing usnic acid, echinocarpic acid (major), conechinocarpic acid (minor) and hirtifructic acid (trace).

This new species would appear to be closely related to *Relicina samoensis* (Zahlbr.) Hale as they have comparable thalli, narrow lobes, a black lower surface and lack isidia. However the thalli of *R. terricrocodila* are compact, with contiguous, sublinear lobes with acute axils (to *ca*. 30°), dense cilia, and dense retrorse apothecial rhizines, whereas *R. samoensis* has separate, more markedly linear lobes with broader lobe-axils (*ca*. > 50°), moderate cilia and retrorse rhizines. The two species also differ chemically. Thus the major medullary substances in both species are echinocarpic acid and conechinocarpic acid, but *R. terricrocodila* also produces hirtifructic acid (Elix & Johnston 1986). The latter substance also occurs in *Relicina hirtifructa* (Kurok.) Streim. and *Relicina fijiensis* Elix & Johnston, although the structure of this compound remains unknown. This new species is morphologically similar to *R. fijiensis* but the latter species has larger, more robust thalli, coronate apothecia and lacks echinocarpic acid and conechinocarpic acid. This new species is known only in collections from the type locality.

Relicinopsis stevensii Elix & Johnston, sp. nov. Figure 13

Species cum thallo ut in *Relicinopsis rahengensis* sed ab hac specie nonisidiato differt.

Type. Australia. Queensland. On isolated tree growing on a ridge of conglomerate in dry open country, Broken River, 230 km north-west of Charters Towers, *G. N. Stevens 3435*, 1975 ; MEL-holotype.

Thallus small foliose, corticolous, adnate to tightly adnate, yellow-green, *ca*. 1.5 cm in diameter; *lobes* subirregular, contiguous, 0.8-1.0 mm wide, ± imbricate, dichotomously to subirregularly divided, margins eciliate. *Upper surface* convex, continuous, shiny, lacking soredia and isidia; medulla white. *Lower surface* pale tan, moderately rhizinate, rhizines concolorous with the lower surface, simple. *Apothecia* common, adnate, to 1 mm in diameter, disc shallowly concave, dark brown; asci 8-spored, spores simple, colourless, ellipsoid, 6-8 x 4-5 µm.

Chemistry. Thallus K-; medulla K-, C-, KC+ yellow, P-; containing usnic acid, barbatic acid (major), 4-O-demethylbarbatic acid (minor), obtusatic acid (trace), norobtusatic acid (trace), 3-α-hydroxybarbatic acid (trace), atranorin (trace).

In some aspects this new species resembles *Relicinopsis rahengensis* (Vainio) Elix & Verdon. Both species are characterised by narrow, eciliate lobes with a pale lower surface, and the presence of the barbatic acid complex in the medulla. However *R. rahengensis* is clearly distinguished by the production of cylindrical isidia, and can be considered the isidiate counterpart of *R. stevensii*. *R. stevensii* is known only from the type locality.

Xanthoparmelia callifolioides Adler, Elix & Johnston, sp.nov. Figure 14

Species cum thallo ut in *Xanthoparmelia versicolor* sed ab hac specie subtus pallido differt.

Type. Argentina. Salta Province. On soil and pebbles, 50 m above the road, Las Pailas, 2280 m, *M. T. Adler*, ii.1986; BAFC-holotype; ANUC, US-isotypes.

Thallus foliose, loosely attached to soil or debris, pale yellow-green, forming irregular patches or rosettes to 10 cm in diameter; *lobes* variable, subirregular to linear-elongate, often forming a dense, imbricate mat, with broad primary lobes with subrotund apices, 2-4 mm wide, with narrower (0.7-1.2 mm wide); elongated, subdichotomously divided, revolute to weakly convolute secondary lobes or lobules developing from the centre. *Upper surface* shiny at the apices, dull within, smooth, emaculate, lacking soredia and isidia; medulla white. *Lower surface* pale tan to light brown, apices darker, sparsely to moderately rhizinate, rhizines grouped subapically, darker brown, simple, tufted, or rarely dichotomously divided, slender, 1-2 mm long. *Apothecia* not seen. Pycnidia common, minute, punctiform, immersed in the thallus.

Chemistry. Cortex K-; medulla K+ yellow-dark red, C-, KC-, P+ red-orange; containing usnic acid, salazinic acid (major), consalazinic acid (minor), norstictic acid (± trace), protocetraric acid (± trace).

This species is characterised by the terricolous substrate, the revolute secondary lobes and the production of salazinic acid and consalazinic acid in the medulla. Morphologically this species resembles *X. versicolor* Hale as both species form extended thalli on soil, produce revolute to subterete lobulae and contain salazinic acid. However *X. callifolioides* is readily distinguished by the pale brown lower surface, this being jet black in *X. versicolor*. In many respects this new species also resembles *X. taractica* (Krempelh.) Hale but is distinguished by the revolute secondary lobes (these are more or less flat in *X. taractica*). Another related species, *X. alternata* Elix & Johnston, differs in having narrower lobes and developing terete, coralloid, isidia-like lobules in the centre of the thallus. At present this new species is known only from the type locality.

Specimen Examined
ARGENTINA. Salta Province. On rock, spreading on to soil, type locality, *M. T. Adler*, ii. 1986 (ANUC).

Xanthoparmelia nigraoleosa Elix & Johnston, sp.nov. Figure 15

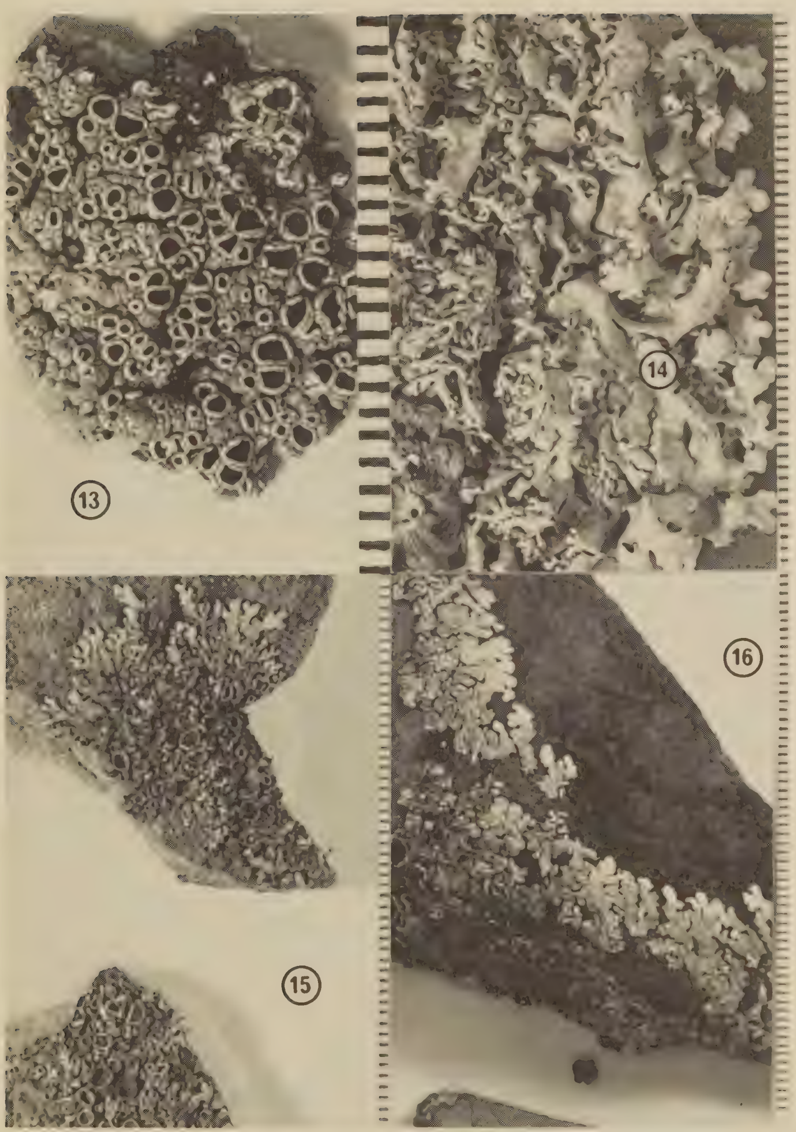
Species cum thallo ut in *Xanthoparmelia oleosa* sed ab hac specie colore nigro subtus differt.
Type. Australia. South Australia. On sandstone rocks in open *Eucalyptus* woodland, Flinders Ranges, lower slopes of Mt. Remarkable, Melrose, 32°35'S, 138°11'E, 500m, *J.A.Elix 17748 & L.H.Elix,* 26.x.1984; CBG-holotype.
Thallus small foliose to subcrustose, saxicolous, tightly adnate, yellow-green but darkening with age and becoming greyish-black, 3-6 cm in diameter; *lobes* irregular to sublinear-elongate, 0.8-1.5 mm wide, irregularly branched, barely imbricate but contiguous, becoming cracked and areolate in the older central portion of the thallus, areolae *ca.* 1.0 mm in diameter. *Upper surface* opaque, emaculate, shiny and black-marginate near the apices, older lobes becoming cracked and areolate, lacking soredia and isidia; medulla white. *Lower surface* black, often brown at the lobe apices, moderately rhizinate, rhizines black, simple, slender. *Apothecia* common, adnate to substipitate, 1.0-2.5 mm in diameter, the disc concave, dark brown, margin thin, continuous, amphithecium smooth; spores (8), ellipsoid, 7-8 x 4-5 µm.
Chemistry. Cortex K+ yellow; medulla K-, C-, KC-, P- ; containing usnic acid, constipatic acid (major), protoconstipatic acid (major), dehydroconstipatic acid (± minor), atranorin (minor).

This distinctive new species is characterised by the black lower surface, the small foliose to subcrustose growth habit and the production of the fatty acids, dehydroconstipatic acid, constipatic acid and protoconstipatic acid, in the medulla. Morphologically and chemically *X. nigraoleosa* closely resembles *X. oleosa* (Elix & Armstrong) Elix & Nash as both have similarly adnate thalli which become ± areolate in the older portions, lack soredia and isidia and contain the same medullary fatty acids. However *X.nigraoleosa* is clearly distinguished by the black lower surface. *X.oleosa* has a tan to dark brown lower surface. This species has been previously confused with the South African species, *X. subnigra* Hale (Elix & Johnston 1987c), a morphologically similar species but with larger thalli, broader lobes and containing a different constellation of aliphatic acids [*X. subnigra* contains constipatic acid (minor), protoconstipatic acid (minor), pertusaric acid (trace), unknown fatty acids R_F(15% acetic acid/toluene) 0.34 (major), 0.38 (major), 0.36 (minor), 0.32 (trace), 0.18 (trace), 0.40 (trace) - the latter acids also occur in *X. subdecipiens* (Vainio) Hale]. At the present time this new species is known only from rock outcrops in South Australia.

Specimens Examined
SOUTH AUSTRALIA. On sandstone rocks in open *Eucalyptus* woodland, type locality, *J. A. Elix 17758 & L. H. Elix,* 26.x.1984 (ANUC); on quartzite rocks in pasture, Kangaroo Island, just E of Wisanger Park Homestead, 35°37'S, 137°28'E, 80 m, *J. A. Elix 19628 & L. H. Elix* (ANUC).

Xanthoparmelia prodomokosii Hale, Elix & Johnston, sp.nov. Figure 16

Species cum thallo ut in *Xanthoparmelia subdomokosii* sed ab hac specie deminuta, arcte adnata et skyrino deficiente differt.
Type. Australia. Northern Territory. On sandstone rocks with a southerly aspect in *Acacia-Callitris* woodland, Macdonnell Range, 1 km east of Pine Gap, 23°49'S, 133°45'E, 600 m, *J. A. Elix 11309 & L. A. Craven*, 17.ix.1983; CBG-holotype.



Figures 13-16. New species of Parmeliaceae. 13, *Relicinopsis stevensii* (holotype in MEL); 14, *Xanthoparmelia callifolioides* (holotype in BAFC); 15, *Xanthoparmelia nigraoleosa* (holotype in CBG); 16, *Xanthoparmelia prodomokosii* (holotype in CBG). Scale in mm.

Thallus foliose, saxicolous, adnate, pale yellow-green, 5-7 cm in diameter; *lobes* sublinear-elongate to subirregular, contiguous or slightly imbricate, apices ± rotund, 1.0-2.5 mm wide. *Upper surface* flat, shiny, emaculate, often tangentially or irregularly cracked, older lobes becoming rugulose and ± areolate, often with black margins, lacking soredia and isidia; medulla white. *Lower surface* pale brown to brown, moderately to sparsely rhizinate, rhizines simple, concolorous with the lower surface or dark brown, slender. *Apothecia* common, 1-2(-8) mm in diameter, disc dark brown to black, margin inrolled at first, then thin, entire, exciple smooth; spores colourless,ellipsoid, 6-8 x 4-5 µm.
Chemistry. Cortex K-; medulla K-, C-, P-; containing usnic acid, hypoprotocetraric acid (major), 4-O-demethylnotatic acid (± trace), scabrosin 4,4'-dibutyrate (±), scabrosin 4-acetate 4'-butyrate (±), scabrosin 4-acetate 4'-hexanoate (±), scabrosin 4,4'-diacetate (± trace), unknown scabrosins (± traces).

Previously this new species has been confused with the South African lichen *Xanthoparmelia subdomokosii* (Hale) Hale (which apparently does not occur in Australia), since both have a pale lower surface, lack soredia and isidia and contain medullary hypoprotocetraric acid. However whereas *X. subdomokosii* has larger thalli (to 12 cm), with broader (2-4 mm wide), adnate to loosely adnate, continuous lobes, *X. prodomokosii* has smaller thalli (to 7 cm), with narrower (1-2.5 mm wide), tightly adnate lobes which often become areolate with age. In addition the lower medulla of *X. subdomokosii* normally contains significant quantities of the orange pigment skyrin (K+ purple), but this compound is absent in *X. prodomokosii*. This new species is quite common in arid Central Australia and also occurs in South Africa.

Specimens Examined
WESTERN AUSTRALIA. On rock outcrop on south-facing slope, *ca.* 11 km W of Yeelirrie Station, *D. H. S. Richardson 69*, 2.iii.1980 (PERTH 000745).
NORTHERN TERRITORY. On sandstone rock, west face of Ayers Rock, 630 m, *J. A. Elix 11072 & L. A. Craven*, *J. A. Elix 11073 & L. A. Craven,* 10.ix.1983 (ANUC); on sandstone rock, exposed arid ridge, James Range, 88 km S of Alice Springs along the Stuart Highway, 24°19'S, 133°28'E, 470 m, *J. A. Elix 11132 & L. A. Craven,* 11.ix.1983 (ANUC); on exposed sandstone rock with a southerly aspect, Macdonnell Range, Serpentine Gorge National Park, 23°45'S, 132°58'E, 670 m, *J. A. Elix 11256 & L. A. Craven,* 15.ix.1983 (ANUC); on weathered granite in arid scrubland, Carmichaels Tourist Camp, Macdonnell Range, Alice Springs, 23°42'S, 133°52'E, 600 m, *J. A. Elix 11285 & L. A. Craven,* 17.ix.1983 (ANUC); on sandstone ledges with a southerly aspect in open mulga woodland, Macdonnell Range, 10 km N of Alice Springs, 1.5 km W of Stuart Hwy., 23°37'S, 133°52', 680 m, *J. A. Elix 11366 & L. A. Craven,* 18.ix.1983 (ANUC).
REPUBLIC OF SOUTH AFRICA. Cape Province. On large granite domes and boulders in karoo, Nieuwoudtville Nature Reserve outside Nieuwoudtville off Hwy. 27, Grid 3119 AC., 800 m, *M. E. Hale 72, 138*, 29.i.1986 (US).

New Records of Parmeliaceae for Australia

Xanthoparmelia brunnthaleri (Stein. & Zahlbr.) Hale
This species was known previously from South Africa.
Chemistry. Cortex K-; medulla K-, C-, P-; containing usnic acid, scabrosin 4,4'-diacetate, unknown scabrosins (± traces).
Specimen Examined
NORTHERN TERRITORY. On granite rocks in mulga scrub, Macdonnell Range, 10 km north of Alice Springs along Stuart Hwy., 23°37'S, 133°53'E, 680 m, *J. A. Elix 11334 & L. A. Craven*, 18.ix.1983 (ANUC).

Xanthoparmelia subpigmentosa Hale
This species has previously been reported from South Africa (Hale 1984).
Chemistry. Cortex K-; upper medulla K+ yellow-dark red, C-, P+ red-orange; lower medulla K+ violet; containing usnic acid, salazinic acid (major), consalazinic acid (minor), skyrin (minor).

Specimen Examined
NEW SOUTH WALES. On exposed rocks in subalpine grassland, Kosciusko National Park, New Chums Hill, above the old Kiandra cemetery, 1460 m, 35°52'S, 148°30'E, *J. A. Elix 19123 & H. Streimann,* 10.vi.1985 (ANUC).

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NOTES ON HYPHOMYCETES. LVII.
CORYNESPORA BISEPTATA, RECLASSIFIED IN CORYNESPOROPSIS

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ABSTRACT

Corynespora biseptata M.B. Ellis is reclassified in the genus *Corynesporopsis* Kirk, as *C. biseptata* (M.B. Ellis) Morgan-Jones. It is described and illustrated.

INTRODUCTION

The segregate genus *Corynesporopsis* Kirk was established to accommodate *Corynespora quercicola* Borowska, which was not considered to be congeneric with *Corynespora cassiicola* (Berk. & Curt.) Wei [= *Corynespora mazei* Güssow], the type species of *Corynespora* Güssow (Kirk, 1981a). *Corynesporopsis* differs from *Corynespora* in having typically catenate, short-cylindrical to ellipsoid, euseptate conidia. Although the two genera have similar conidiophores and both show monotretic conidiogenesis, conidia of *Corynespora* are mostly solitary, long-cylindrical or obclavate, often rostrate and euseptate.

A second species, *Corynesporopsis uniseptata* Kirk, was added to the genus later in the same year (Kirk, 1981b). This differs from *C. quercicola* in having smaller conidiophores, one-septate conidia, with dark pigmentation at the septum, and occurring on leaves rather than wood. Conidiophores of *C. quercicola* were noted to rarely proliferate percurrently, a common occurrence in species of *Corynespora* (Ellis, 1957; 1960; 1971). No such proliferation was noted in *C. uniseptata*. Kirk (1981a) experienced difficulty in determining precisely how percurrent proliferation occurred. He stated that it was not clear whether proliferation occurs from a conidiogenous cell that remains active following secession of conidia, whether it results from conidiophore regeneration following a dormant period or damage, or from a conidiogenous cell that fails to produce a conidium.

Corynesporopsis indica Kirk, a third species described two years later (Kirk, 1983) was compared with the two known species of *Hemicorynespora* M.B. Ellis, *H. deightonii* M.B. Ellis, the type, and *H. mitrata* (Penz. & Sacc.) M.B. Ellis. *Hemicorynespora* has morphologically similar conidiophores to *Corynespora* and *Corynesporopsis* but its conidia are produced solitarily on successive percurrent proliferations, are mitre-shaped or limoniform, and have

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a distinctly truncate base. Kirk (1983) noted the base of the conidia in *C. indica*, whether produced terminally on the conidiophore or from a subtending conidium in an acropetal chain, to be similarly truncate. Conidia in an intermediate position, or at the base of a chain of three, are truncate at both ends. Taking into account this similarity, Kirk suggested that conidiogenesis in *C. indica* and *Hemicorynespora* may be identical. By scanning electron microscopy it was shown that, although abrupt truncation suggests a flat conidial base, the base is, in fact, concave with a central pore defining the precise conidiogenous locus. The concave surface of the conidial base in effect closely abuts onto the convex apex of the conidiogenous cell. Conidia of *C. indica* are distinctive in having a median septum obscured by a dark brown band, reminiscent of septa seen in species of *Bispora* Corda. Other than the septa, the conidial shape and the fact that the conidia catenate, there is little difference between *Corynesporopsis* and *Hemicorynespora*.

Holubovā-Jechovā and Mercado (1986) redescribed and illustrated *C. quercicola* from a collection made in Cuba and named a further species, *C. rionensis* Hol.-Jech., bringing the total number to four. The Cuban collection of *C. quercicola* differed from those made in Europe by having slightly longer conidiophores and conidia. Although no mention of percurrent proliferation was made in the description, such proliferation was shown in one of the four conidiophores illustrated. *Corynesporopsis rionensis* has conidia that are similarly shaped to those of *C. indica*, being somewhat doliiform and distinctly truncate at the base, or at both ends where intermediate in position in a chain. Each conidium bears three to five thick, dark septa. The conidiogenous cells of *C. quercicola* were described as being percurrent although only one out of three conidiophores illustrated shows any proliferation. Those of *C. rionensis* were also noted to be percurrent and illustrated as such.

During the course of determining an appropriate classification for *Monotretomyces uniseptatum* Morgan-Jones, Sinclair & Eicker, a number of morphologically similar genera and species were considered (Morgan-Jones *et al.*, 1987). These included *Bispora*, *Corynespora*, *Corynesporopsis*, *Diplococcium* Grove and *Spadicoides* Hughes. It was noted that *Bispora betulina* (Corda) Hughes, *B. novae-zelandiae* Matsushima and *Corynespora biseptata* each bears some resemblance to *Monotretomyces*. A suggestion was made that *C. biseptata* might be better classified in *Corynesporopsis*. Since that time, I have had opportunity to examine the type material of *C. biseptata* and have determined the suggestion to be a valid one. A transfer is therefore made herein.

TAXONOMIC PART

Corynesporopsis biseptata (M.B. Ellis) comb. nov. (Figure 1).

≡ *Corynespora biseptata* M.B. Ellis, *Mycol. Pap.* 76: 27, 1960.

Colonies dense, hairy, black, effuse. Mycelium mostly immersed in the substratum, composed of pale to mid-brown, smooth, branched, septate, 1.5-3.5 um wide hyphae. Swollen, brown, hyphal cells up to 10 um in diameter frequently present at the base of conidiophores. Stromata partly superficial, partly immersed in the substratum, brown, irregular in shape, sometimes rudimentary or extending laterally as a loosely-organized, linearly arranged group of cells or compact and pseudoparenchymatous in texture. Conidiophores

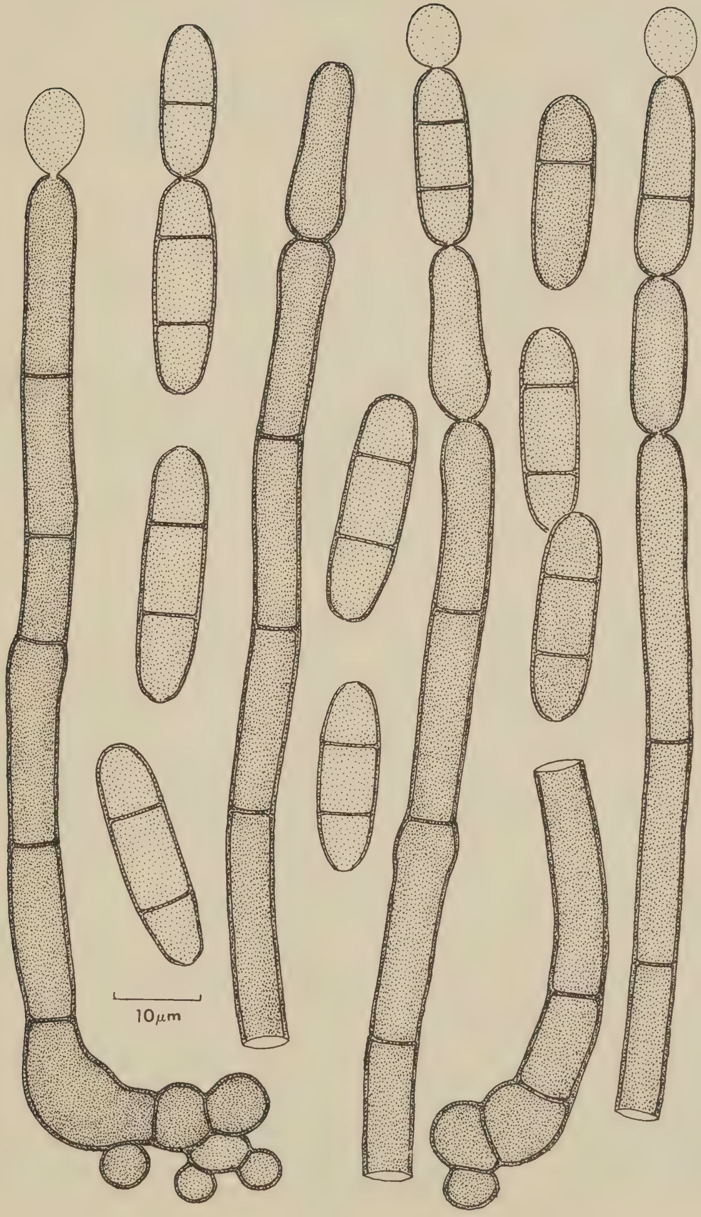

FIGURE 1. *Corynesporopsis biseptata*. Conidiophores and conidia.

borne from cells of the stromata or from hyphae, solitary or, when borne from stromata, loosely caespitose, mononematous, macronematous,erect, more or less straight or slightly curved, septate, brown, often slightly paler toward the apex, smooth, usually with several apical, percurrent, cylindrical or often obclavate proliferations, up to 160 um long, 4.5-7 um wide. Conidiogenous cells monotretic, integrated, determinate. Conidia acrogenous dry, catenate, arising through a single pore at the apex of each conidophore, percurrent proliferations thereof, or successive conidia, cylindrical, more or less straight, obtuse at each end, smooth, pale to mid-brown, mostly 2-septate, with the central cell usually slightly longer than end cells, 18-33 X 7-9 um.

On dead, decorticated wood; United Kingdom.

Collection examined: on dead wood, Dunford House, Midhurst, Sussex, England, M.B. and E.M. Ellis, May 22, 1979, IMI 76701, holotype.

DISCUSSION

Corynesporopsis biseptata fits perfectly in the genus as defined by Kirk (1981a). It quite closely resembles the type species, *C. quercicola*, and *C. uniseptata*, differing only in the detailed morphology and size of its conidia and in the frequent percurrent proliferation of its conidiophores. The two other species, *C. indica* and *C. rionensis*, differ appreciably in the shape of their conidia and in possessing dark pigmented bands obscuring their conidial septa. *C uniseptata*, which has conidia more like those of *C. biseptata* and *C. quercicola* has also, interestingly, darker pigmentation at the septa.

The phenomenon of having dark bands at conidial septa is a feature shared in common with a number of other dematiaceous hyphomycete genera. Among these, *Bispora* bears some morphological resemblance, except for the fact that it has semi-macronematous conidiophores. *Didymobotryum* Sacc., a monotretic, catenate genus, has broadly similar conidia but very different, branched, synnematous conidiophores. When grown *in vitro*, *B. betulina*, however, produces chains of conidia lacking dark bands (Morgan-Jones *et al*., 1987), indicating that this may not be a totally stable characteristic. As discussed previously (Morgan-Jones *et al*., 1987), a species such as *B. betulina*, although usually described as being monoblastic in its conidiogenesis (Hughes, 1953; Ellis, 1971), is very similar in many respects, and in conidial morphology in particular, to such genera as *Corynesporopsis* and *Monotretomyces*. The same is true of *B. novae-zelandiae*. The type species of *Bispora*, *B. antennata* (Pers.) Mason, although much smaller, has a somewhat similar appearance to *Taeniolella exilis* (Karst.) Hughes, the type species of *Taeniolella* Hughes, and is more clearly monoblastic. The discontinuities that are employed to separate genera, especially with regard to cell wall relationships may, in some instances, be more imagined than real. The use of the terms monoblastic and monotretic is often quite problematic and the use of conidial truncation as a hallmark for the former is far from being reliable. Genera such as *Corynesporella* Munjal and Gill and *Podosporium* Schw., for example, whose conidiogenesis is considered to be tretic (Ellis, 1971), bear conidia with a truncate base. Kirk (1983), in his scanning electron microscope study of the conidial base of *C. indica*, noted the presence of a central pore bounded by a somewhat irregular, ring-like border beyond which a wider, relatively smooth wall area occurs. It would appear that during the process of conidial enlargement and maturation, when the conidial wall is still relatively thin, the peripheral smooth area partly invaginates into the

496	line	36	for	*P.*	read	*Parmotrema*
514	line	45	for	*C.*	read	*Corynesporopsis*
515	line	10	for	*C.*	read	*Corynesporopsis*
524	fig.	7	for	Dicheirina	read	Dicheirinia
		7	for	Ypsilopsora	read	Ypsilospora
		7	for	Sphenopsora	read	Sphenospora
529	fig.	14	for	Sphaeophragmium	read	Sphaerophragmium

body of the conidium over the convex apex of the conidiophore, becoming concave as a result. The increasing weight of the developing conidium may be at least partly responsible for this. The final effect is that when the conidial base is viewed from the side it appears flat. It may well be that as a conidium matures, its exposed wall becomes increasingly thicker, particularly at the juncture with the concave portion, whereas the latter remains comparatively thin. Deposition of wall material at this juncture creates a ring-like thickening that appears as a dark, truncate hilum at the conidial base when viewed laterally. Such a hilum is a feature commonly occurring in conidia of *Corynespora* and *Corynesporella*.

Ellis (1960) described the conidiophore of *C. biseptata* as proliferating through its apical pore after the first conidium or chain of conidia has fallen. It is, however, as Kirk (1981a) pointed out in connection with *C. quercicola*, often difficult to determine the sequence of events vis-ã-vis proliferation. With isolation and growth of such fungi *in vitro* the process could be followed more precisely. In the case of *C. biseptata* it appears, at least in some instances, that the first conidium initial produced at the apex of a conidiogenous cell fails to mature into a septate conidium but such an entity gives rise to a conidium distally. In shape and morphology, except for septation, the initial has the characteristics of a conidium, but could easily be incorrectly interpreted as having been produced following secession of a preceding conidium and referred to as a proliferation. It seems possible that true conidiophore proliferations, in addition to aborted conidial elements, might be present, but it is impossible to be certain by examination of a dried herbarium specimen.

ACKNOWLEDGMENTS

Dr. B.C. Sutton, CAB International Mycological Institute, Kew, Surrey, United Kingdom, afforded me the opportunity to examine the type material of *C. biseptata* and Dr. Roger D. Goos, Department of Botany, University of Rhode Island, reviewed the manuscript.

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ONTOGENY AND MORPHOLOGY OF TELIOSPORES (PROBASIDIA) IN UREDINALES AND THEIR SIGNIFICANCE IN TAXONOMY AND PHYLOGENY

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Abstract

At least four types of spore ontogeny and numerous morphological variations, such as cell arrangement, surface ornamentation, and pigmentation exist in teliospores (probasidia) of Uredinales (rust fungi). The diverse morphology found in probasidia of rust fungi is unique in Basidiomycetes. Taxonomic and phylogenetic significance of spore ontogeny and morphological characteristics of teliospores are discussed within Uredinales and in comparison with other groups of fungi in the Heterobasidiomycetes.

This paper describes four types of teliospore ontogeny exist in the rust fungi (Uredinales) and discusses their significance in taxonomy and phylogeny.

Rust fungi are a unique group of Heterobasidiomycetes with about 5000-6000 recognized species and about 105 'good' genera (Cummins and Hiratsuka 1984). They are parasites of many gymnosperm and angiosperm families. Rust fungi are unique among Basidiomycetes because (1) they possess spermogonia, (2) up to six morphological and functional spore states exist in one species, and (3) they are obligate parasites of the higher plants. Many species need only one kind of plant to complete their life cycles (autoecious), but others require two unrelated groups of host plants to do so (heteroecious).

A part of this study was presented in a symposium entitled "Structure and systematics of Heterobasidiomycetes" at the 14th International Botanical Congress, Berlin, W.Germany, 1987. Figs. 1,3,5-7,9,and 11-16 are adopted from Cummins (1959) with the permission of Dr. G. B. Cummins.

The name teliospore has been used traditionally for one spore state of rust and smut rust fungi. But in a more universal terminology for Basidiomycetes proposed by Donk (1954) and Talbot (1973) and used in most of the recent taxonomic work in Basidiomycetes, these structures are called PROBASIDIA, since karyogamy occurs in them. Structures commonly called basidia in rusts are METABASIDIA, according to the Donk-Talbot system of terminology, because meiosis occurs in them.

In many other groups of Basidiomycetes, probasidia are replaced by metabasidia internally and no distinct structures called probasidia exist. Therefore, clear distinction between pro- and meta-basidia is a somewhat unique characteristic of rust fungi. Some of the rust genera such as Coleosporium, Chrysopsora, Chrysella, Ochropsora, and Goplana also lack distinct separation of pro- and meta-basidia. It is noteworthy that all known genera of rust fungi with this type of basidia are colorless and germinate without dormancy. Genera of rusts having this type of telial germination may provide some clues to phylogenetic links with other groups of Basidiomycetes. Uredinologists often call this internal basidia formation, but the term is not appropriate, as pointed out by Oberwinkler (1982). On the other hand, some genera of Heterobasidiomycetes, such as Uredinella, Septobasidium, Eocronartium, Cystobasidium, and Jola, are considered to be closely related to rust fungi (Julich 1982; Bandoni 1984) and some authors even suggest that they be included in the rust fungi (Hennen & Buritica 1980, Leppik 1972). They have distinctly separate probasidia or cysts, which are equivalent to teliospores of rusts, but they are morphologically simple and without much variation. On the other hand, tremendous morphological variation exists among teliospores (probasidia) of the rust fungi (Fig. 1), such as variations in spore arrangement, number of cells in a spore, and spore surface ornamentation.

The presence of gelatinous basidiocarps is a common and important feature of most of the groups of Heterobasidiomycetes, but they are absent in rust fungi. Some of the telia of rusts have a gelatinous or waxy appearance; for example, many species of Gymnosporangium have gelatinous telia, but they are composed of spores and hygroscopic pedicels of spores, and are not equivalent to gelatinous basidiocarps of other Heterobasidiomycetes. This wide morphological variability of teliospores or probasidia

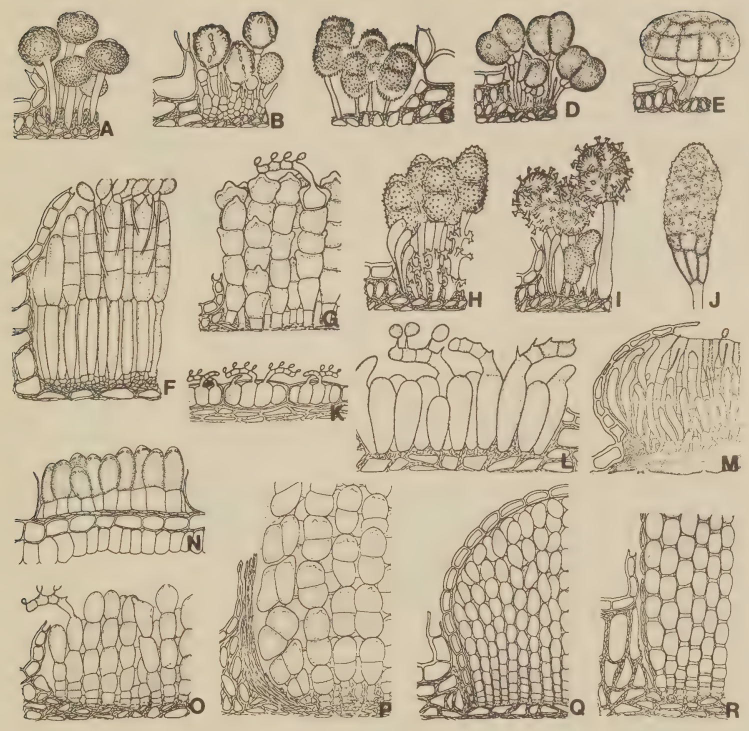

Fig. 1. Morphological variations of teliospores of rust fungi.

is one of the unique morphological features of rust fungi. The only other group of fungi that may have some degree of morphological variations in probasidia is the Ustilaginales or smut fungi, but the morphological and ontogenical variability in smuts is far less than in the rust fungi.

Since teliospores are considered to be the teleomorph or perfect state of the rust fungi under the International Code of Botanical Nomenclature, morphology of teliospores is important in the taxonomy of rust fungi, especially in defining families and genera. It has been traditional to divide teliospores into two major families: Melampsoraceae, including genera with sessile teliospores, or teliospores without stalks or pedicels, and

Pucciniaceae, for those genera with teliospores having stalks or pedicels. However, it has become obvious that this simple division of Uredinales creates an unnatural classification, especially since more genera and species occurring in tropical regions have been described. With added information on morphological types of spermogonia (Hiratsuka & Cummins 1963, Hiratsuka & Hiratsuka 1980) and other criteria, several additional families have been proposed by Savile (1976, 1980), Leppik (1972), and Azbukina (1974). Cummins & Hiratsuka (1983, 1984) proposed the division of the rust fungi into 14 families, as shown below.

1. Pucciniastraceae (Arthur) Gaeumann
2. Coleosporiaceae Dietel
3. Cronartiaceae Dietel
4. Melampsoraceae Schroeter
5. Phakopsoraceae (Arthur) Cummins and Y. Hiratsuka
6. Mikronegeriaceae Cummins and Y. Hiratsuka
7. Chaconiaceae Cummins and Y. Hiratsuka
8. Uropyxidaceae (Arthur) Cummins and Y. Hiratsuka
9. Pileolariaceae (Arthur) Cummins and Y. Hiratsuka
10. Raveneliaceae (Arthur) Leppik
11. Phragmidiaceae Corda
12. Sphaerophragmiaceae Cummins and Y. Hiratsuka
13. Pucciniaceae Chevalier
14. Pucciniosiraceae (Dietel) Cummins and Y. Hiratsuka

Hughes (1970) surveyed the spore ontogeny of various spore states of rust fungi including teliospores and suggested the occurrence of three different types of teliospore ontogeny. I agree with his basic categorization and want to expand what he suggested. I categorize them into four types.

Type I:

Teliospores are produced mostly within host tissue and result from simple proliferation of terminal cells of the hyphae (Fig. 2). Spores are produced randomly in intercellular spaces of mesophyll of host leaf tissue, as in the genera *Uredinopsis* and *Melampsoridium*, or are produced within epidermal cells,as in *Milesina*, *Hyalopsora*, and *Melampsorella*. Teliospores of *Uredinopsis* are least organized, having spore balls of one to several cells scattered in the mesophyll tissue of fern hosts. This type of teliospore ontogeny has been documented by S. M. Pady in 1933. All genera belonging to the family Pucciniastraceae

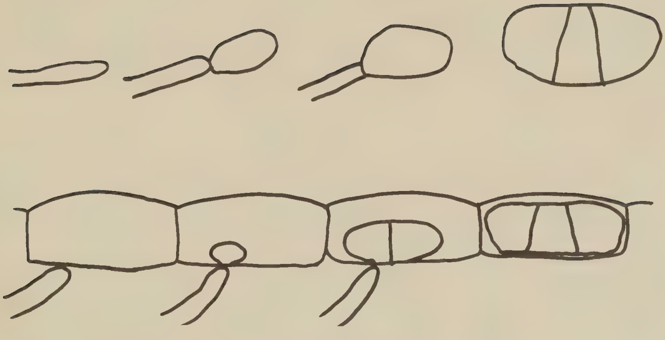

Fig. 2. Type I teliospore ontogeny

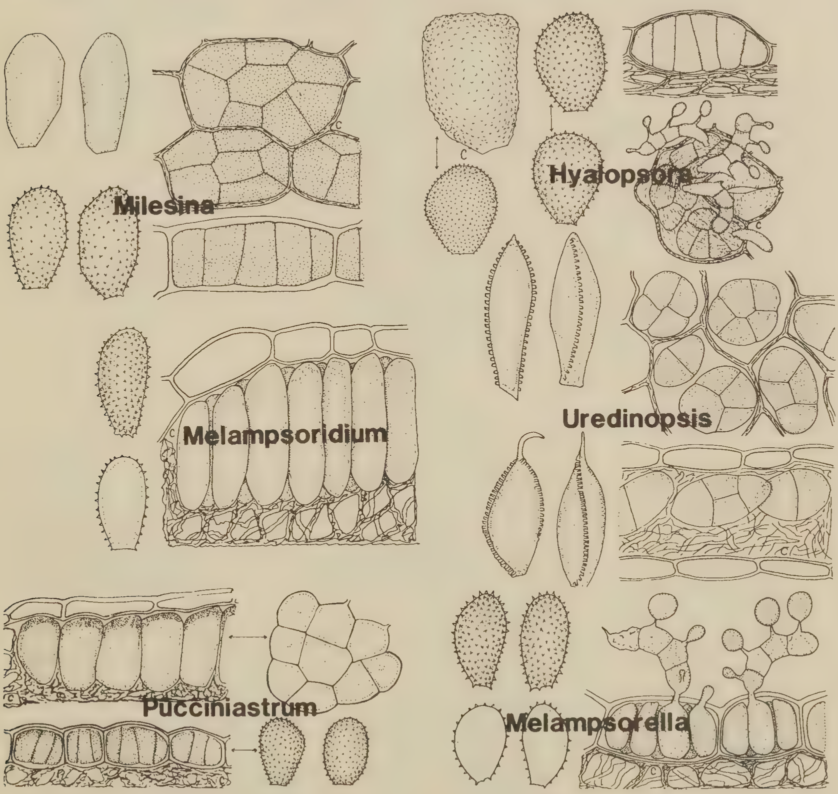
Milesina
c
c
Hyalopsora
c
Melampsoridium
c
Uredinopsis
c
Pucciniastrum
c
c
Melampsorella
c

Fig. 3. Representative genera of Pucciniastraceae.

(Fig. 3) have this type of teliospores, and conifers are their aecial hosts. Telial hosts of Uredinopsis, Milesina, and Hyalopsora are ferns. All genera of this family have spermogonia of Group I. All teliospores have simple morphology, that is, smooth lightly pigmented or hyaline spore walls.

Type II:

Sori are more organized than those of Type I. Spores are laterally adherent and produce crusts of spores that often appear as cushions of indeterminate growth or tall column-like structures (Fig. 5). They are one spore deep (Melampsora), a few spores deep (Coleosporium, Phakopsora), or many spores deep (Chrysomyxa, Cronartium) and are produced on a sporogenous basal cell layer. Rust genera belonging to families Coleosporiaceae (Fig.6), Cronartiaceae, Melampsoraceae (Fig. 7), Phakopsoraceae (Fig. 8), and Raveneliaceae can be assigned to this type. Some genera in Phakopsoraceae, such as Nothoravenelia and Uredopeltis, and genera in Raveneliaceae such as Ravenelia and Kernkampella (Fig. 9) may well be placed in the pedicellate spore type, which I will discuss later as Type IV. However, I think they belong to Type II. Teliospore heads of these rusts can be considered as spore clusters produced on sporogenous basal cells and raised up with single or multicellular stalks. Therefore, stalked spore balls of this type always have sporogenous basal cells below the spore clusters and they are ontogenically different from Type IV teliospores.

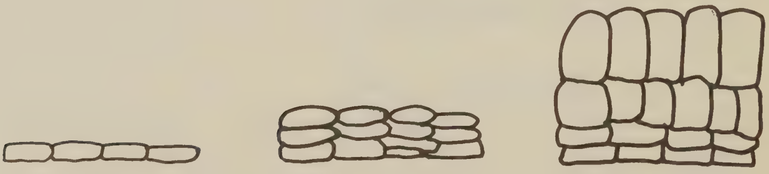

Fig. 4. Type II teliospore ontogeny.

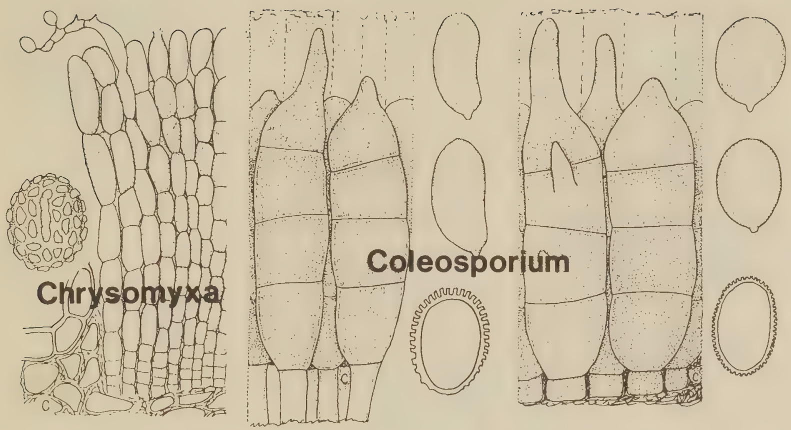
Chrysomyxa
Coleosporium
C
C
C

Fig. 5. Representative genera of Coleosporiaceae.

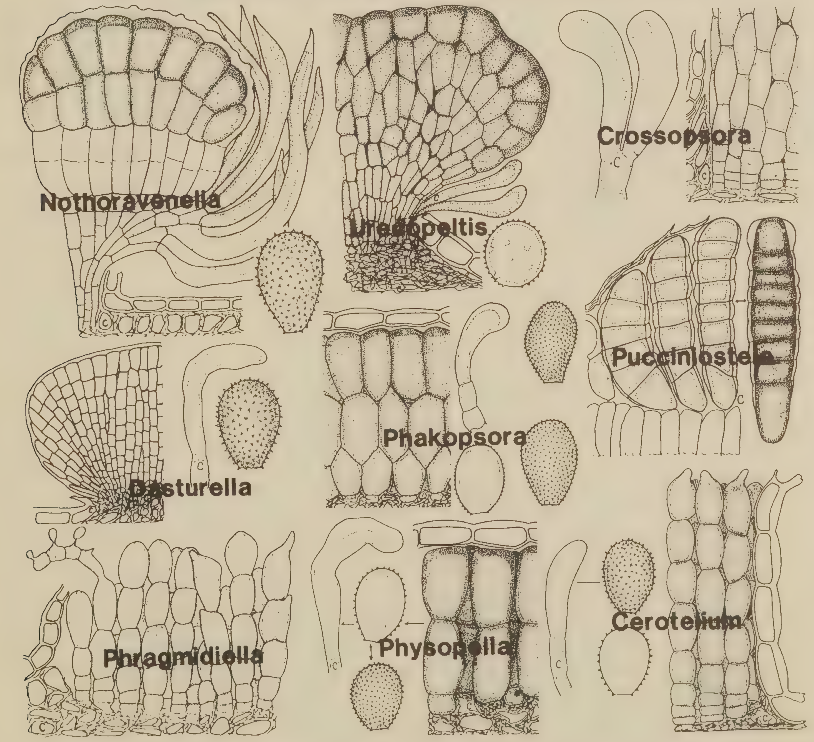
Nothoravenella
Uredopeltis
Crossopsora
Pucciniostele
Dasturella
Phakopsora
Phragmidiella
Physopella
Cerotelium

Fig. 6. Representative genera of Phakopsoraceae.

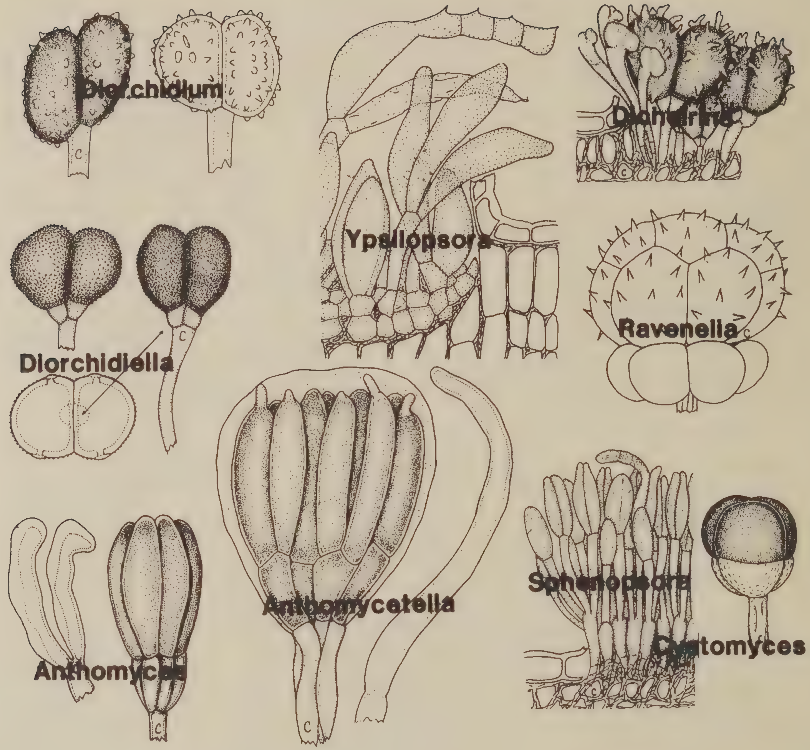
Diorchidium
Dicheirinia
Ypsilopsora
Ravenella
Diorchidiella
Anthomycetella
Sphenospora
Cystomyces
Anthomyces
c

Fig. 7. Representative genera of Raveneliaceae.

Type III:

Teliospores are laterally separated and produced in a chain as meristem arthrospores (Fig. 8). Most of the genera of the family Pucciniosiraceae can be included here. In this type, a basal sporogenous cell divides to produce a spore initial and by successive elongation and division of the basal cell a basipetal succession of teliospore initials is formed and pushes up the column of spores. This results in the oldest spore at the tip and the youngest at the bottom. In the case of spores with intercalary cells, each spore initial divides to form two unequal cells, a small proximal intercalary cell and a large distal spore. Basically they have the same spore ontogeny of catenulate aeciospores. Genera of the family Puccinosiraceae have this type of teliospores (Fig. 9). It is speculated that most of the genera belonging to this

515	line	10	for	C.		
524	fig.	7	for	Dicheirina	read	Dicheirinia
		7	for	Ypsilopsora	read	Ypsilospora
		7	for	Sphenopsora	read	Sphenospora
[illegible]	[illegible]	14	for	Sphaeophragmium	read	Sphaerophragmium

family are derived from aecial states of certain rusts by shortening of the life cycles. For this reason, this family is phylogenetically rather heterogeneous.

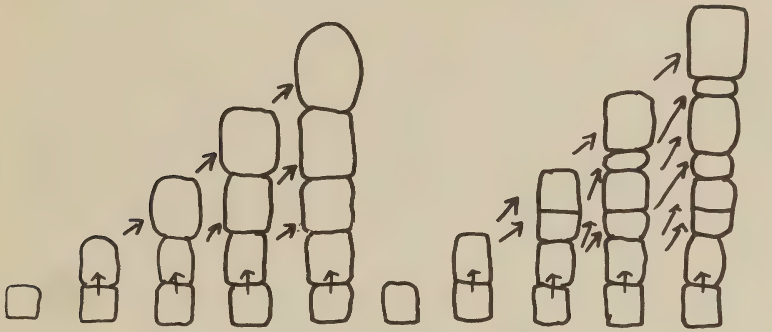

Fig. 8. Type III teliospore ontogeny.

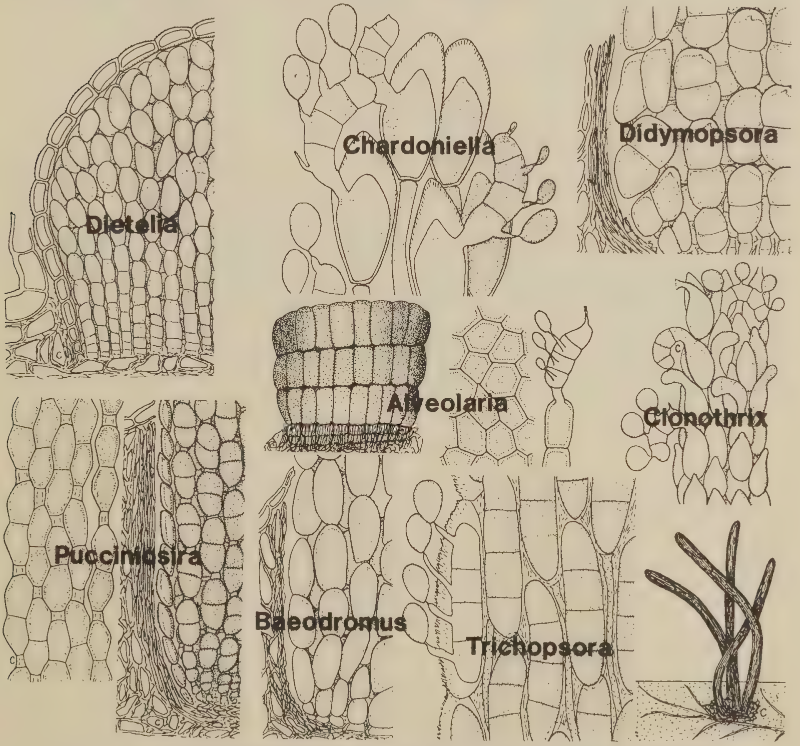
Chardoniella
Didymopsora
Dietelia
Alveolaria
Clonothrix
Pucciniosira
Baeodromus
Trichopsora

Fig. 9. Representative genera of Pucciniosiraceae.

Type IV:

Teliospores are produced mostly on pedicels as sympodioconidia (Fig. 12). In this case teliospores are produced on sporogenous cells. Sporogenous basal cells produce spore initials and the spore initials divide in two; the proximal cell becomes a pedicel and the other becomes the spore. Spore parts may divide one or more times to produce teliospores that are two-celled to multi-celled. Spore initials are produced by successive budding of sporogenous cells one beside the other. The main difference between this and the previous type is that the young new spore initial is produced below the previous one in Type III but occurs separately in Type IV. Teliospores of the largest family of rusts, Pucciniaceae (Fig. 13), as well as Phragmidiaceae (Fig. 14), Uropyxidaceae (Fig. 15), Shaerophragmiaceae (Fig. 16), Pileolariaceae (Fig. 17), Micronegeriaceae, and Chaconiaceae belong to Type IV. Morphological types of spermogonia of this group of rusts are Group V (Pucciniaceae), Group VI (Uropyxidaceae, Sphaerophragmiaceae, Pileolariaceae, Chaconiaceae), Group IV (Phragmidiaceae), and Group III (Micronegeriaceae). Spermogonia of these groups have well-developed bounding structures (periphyses and peridia) and are considered to be phylogenetically advanced. Great variations in spore cell arrangement and surface ornamentation exist in the teliospores of Type IV. Teliospore walls are predominantly heavily pigmented. Some of the stomatosporous genera such as Hemileia, Desmella, and Edythea (Fig. 18) have enlarged sporogenous cells which produce spores in great numbers as blastospores. This may be considered as one of the variations of this type. However, examination of these genera may reveal significantly different ontogeny.

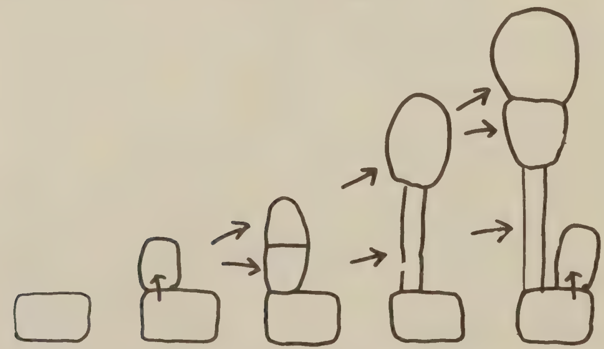

Fig. 10. Type IV teliospore ontogeny.

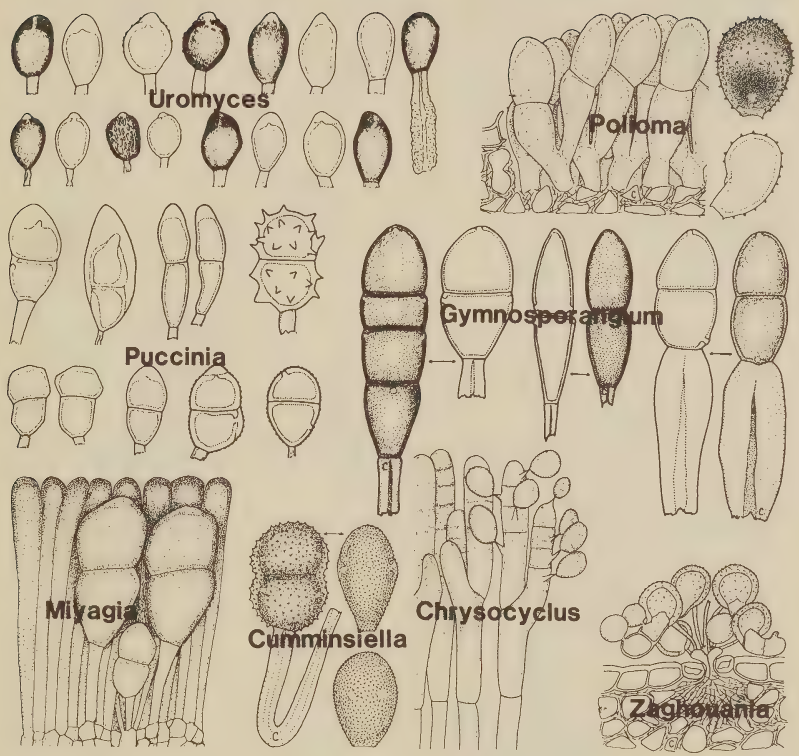
Uromyces
Polioma
Puccinia
Gymnosporangium
Miyagia
Cumminsiella
Chrysocyclus
Zaghouania

Fig. 11. Representative genera of Pucciniaceae.

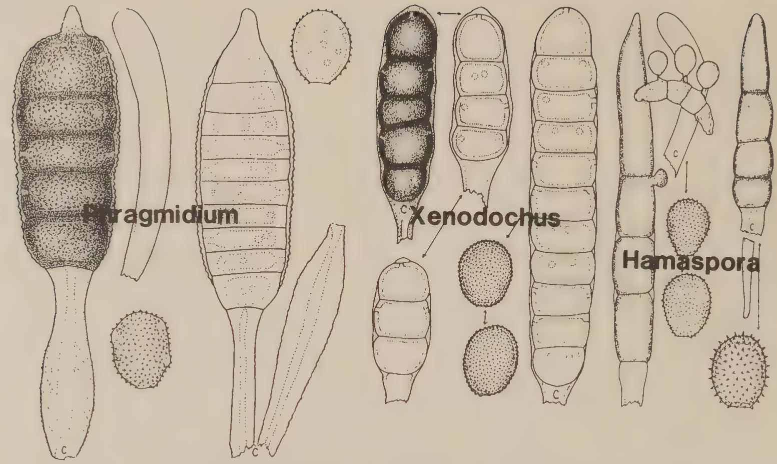
Phragmidium
Xenodochus
Hamaspora
c
c
c
c
c
c
c

Fig. 12. Representative genera of Phragmidiaceae.

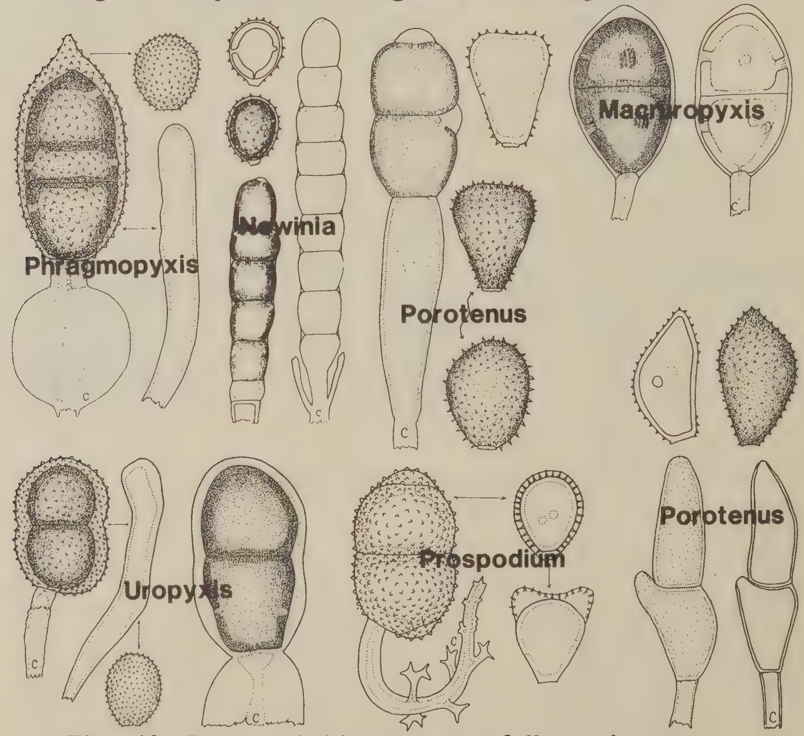
Phragmopyxis
Newinia
Porotenus
Macruropyxis
Uropyxis
Prospodium
Porotenus
c
c
c
c
c
c
c
c

Fig. 13. Representative genera of Uropyxiaceae.

524	fig.	7	for	[illegible]	read	[illegible]
		7	for	Ypsilopsora	read	Ypsilospora
		7	for	Sphenopsora	read	Sphenospora
529	fig.	14	for	Sphaeophragmium	read	Sphaerophragmium
551	line	25	for	*P. hypo-*	read	*Parmelia hypo-*

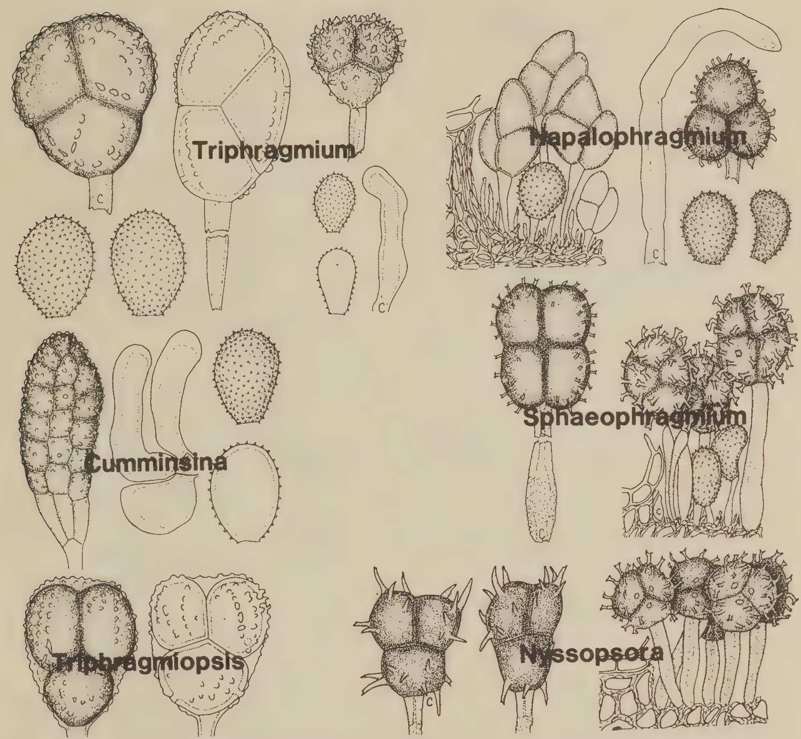
Triphragmium
Hapalophragmium
Cumminsina
Sphaeophragmium
Triphragmiopsis
Nyssopsora

Fig. 14. Representative genera of Sphaerophragmiaceae.

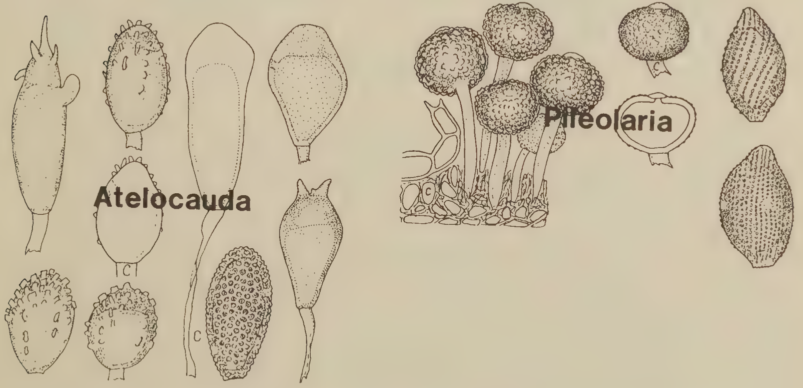
Atelocauda
Pileolaria

Fig. 15. Representative genera of Pileolariaceae.

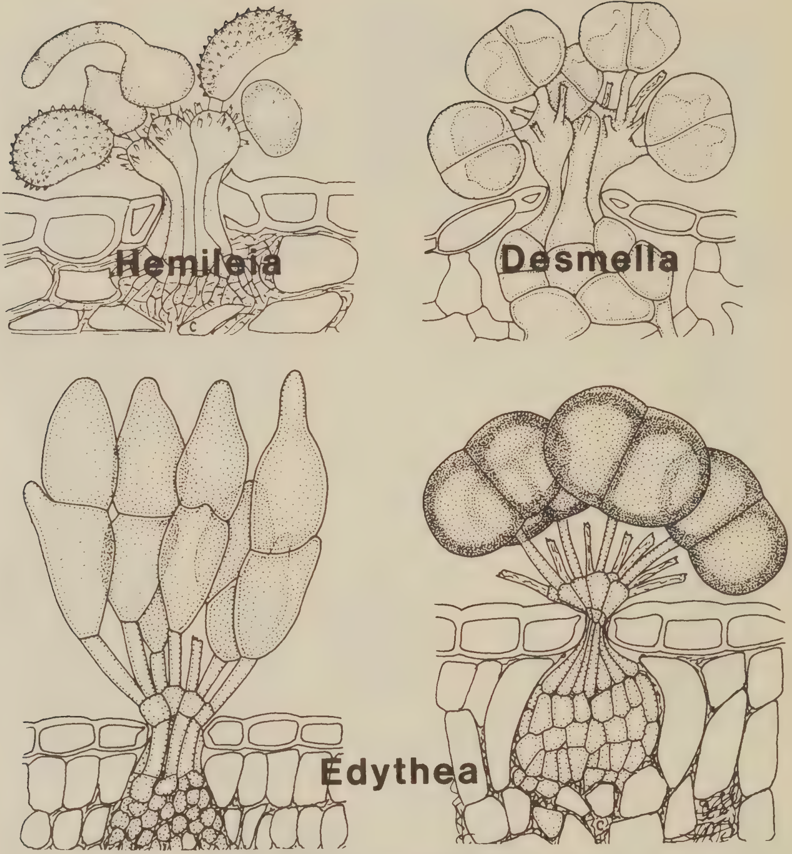

Fig. 16. Genera with stomatosporus telia.

Teliospore ontogeny definitely reflects phylogenetic relationships among rust fungi. Also, well developed teliospores (probasidia) with wide morphological and ontogenical variations demonstrate the unique taxonomic position of Uredinales among Basidiomycetes. The ontogenic types of teliospores discussed here seem to relate to the degree of spore wall pigmentation, variations and complexities of spore wall ornamentation, and variations in teliospore organization. Teliospores range from those of Type I, which are simple, with smooth, colorless or lightly pigmented walls, and embedded within host tissue, to those of Type IV, which are usually highly pigmented and typically pedicellate, and have highly variable organization. Types

II and III are somewhere between Types I and IV. Furthermore, these teliospore groupings seem to correspond to morphological types of spermogonia and support the division of rust fungi into 14 families.

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FIVE NEW SPECIES OF PARMELIA (PARMELIACEAE, LICHENIZED ASCOMYCETES) FROM SOUTHERN AFRICA, WITH NEW COMBINATIONS AND NOTES, AND NEW LICHEN RECORDS

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ABSTRACT

Five new species of *Parmelia* (Parmeliaceae, Lichenized Ascomycetes) are described from southern Africa. They are: *Parmelia adligans* Brusse, *P. arquata* Brusse, *P. ganymedea* Brusse, *P. sigillata* Brusse and *P. verecunda* Brusse. One new name is proposed, *Parmelia capicola* Brusse. Thirteen new combinations are made: *Parmelia ceresensis* (Hale) Brusse, *P. diacida* (Hale) Brusse, *P. endochromatica* (Hale) Brusse, *P. gyrophorica* (Hale) Brusse, *P. lesothoensis* (Hale) Brusse, *P. ochropulchra* (Hale) Brusse, *P. rogersii* (Elix & Jen Johnston) Brusse, *P. stenosporonica* (Hale) Brusse, *P. thamnolica* (Hale) Brusse, *P. transvaalensis* (Hale) Brusse, *P. xanthomelanoides* (Elix & Nash) Brusse, *Porpidia corralensis* (Raes.) Brusse and *Thelotrema berkeleyanum* (Mont.) Brusse. Sixty eight new lichen records are reported for South Africa. Notes on eighteen *Parmelia* species are given.

NEW SPECIES

PARMELIA ADLIGANS Brusse, *sp. nov.*

Thallus crustosus et effiguratus, saxicola, ad 5 cm diametro, 80–160 µm crassus. *Lobi* elongati, 1–6 mm longi, 0,2–1,0 mm lati. *Thallus superne* flavo-viridis, opacus vel ad apices loborum grosse pruinosus, emaculatus, isidiis sorediisque destitutus. *Cortex superior* 10–15 µm crassus. *Stratum gonidiale* 30–50 µm crassum, algis *Trebouxiis*, 4,5–15 µm diametris. *Medulla* albida, 10–70 µm crassa. *Cortex inferior* 10–15 µm crassus. *Thallus inferne* pallide brunneus vel ad apices loborum ater. *Rhizinae* non bene evolutae. *Apothecia* immersa vel sessilia, ad 0,8 mm diametris. *Hypothecium* hyalinum, 25–35 µm crassum, J-. *Subhymenium* hyalinum, 20–80 µm crassum. J+ caeruleum. *Hymenium* hyalinum, 45–55 µm altum, J+ caeruleum. *Asci* clavati, cum tholis J+ caeruleis (figura 1). *Ascosporae* octonae, hyalinae, simplices, ellipsoideae, 8–10 × 4,5–6 µm. *Pycnidia* globosa, circa 100 µm profunda et 75–100 µm lata. *Pycnidiosporae* bacillares, hyalinae, 5,5–8,5 × 0,8 µm. *Thallus* atranorinum, acidum usnicum, acidum sticticum et acidum consticticum continens.

TYPUS: SOUTH AFRICA, Transvaal, **2430** (Pilgrim's Rest): Clearwater Falls on the Treur River a few kilometers upstream from Bourke's Luck Potholes, on rocky NE slope of sandstone and quartzite, in full sun, alt. 1240 m (–DB). *F. Brusse 4452*, 14.i.1986 (PRE, holo-; BM, COLO, LD, iso-). Figure 4.

Thallus crustose and effigurate, saxicolous, to 5 cm across, 80–160 µm thick. *Lobes* elongate, 1–6 mm long, 0,2–1,0 mm wide. *Upper surface* yellow-green, matt to coarse-pruinose at the lobe tips, emaculate, without isidia or soredia. *Upper cortex* 10–15 µm thick. *Algal layer* 30–50 µm thick, algae *Trebouxia*, 4,5–15 µm diam. *Medulla* whitish, 10–70 µm thick. *Lower cortex* 10–15 µm thick. *Lower surface* pale brown, becoming black at the lobe tips. *Rhizines* not well developed. *Apothecia* immersed to sessile, to 0,8 mm across. *Hypothecium* hyaline, 25–35 µm thick, J-. *Subhymenium* hyaline, 20–80 µm thick, J+ blue. *Hymenium* hyaline, 45–55 µm high, J+ blue. *Asci* clavate, eight-spored, tholus J+ blue (figure 1). *Ascospores* hyaline, monolocular, ellipsoid, 8–10 x 4,5–6 µm. *Pycnidia* globose, about 100 µm deep, 75–100 µm wide. *Pycnidiospores* hyaline rods, 5,5–8,5 x 0,8 µm. *Chemistry*: Atranorin, usnic, stictic and constictic acids present.

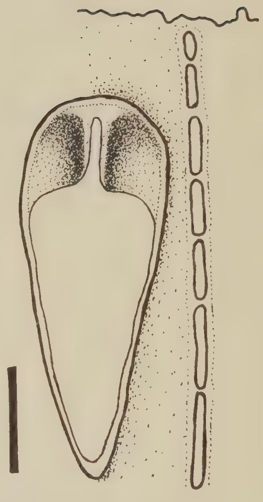

FIGURE 1. — *Parmelia adligans* Brusse, ascus and paraphysis. *F. Brusse 4452*, holotype. Bar = 10 µm.

This new species is related to the salacinic acid containing *Parmelia leptoplaca* (Zahlbr.) Brusse, but contains stictic acid and is distributed in more humid areas than the typical karooid localities of *P. leptoplaca.*

Parmelia adligans may also be related to *P. adhaerens* Nyl. with a similar chemistry, but *P. adhaerens* is more robust and the centre of the thallus is not truely areolate as in *P. adligans. P. adligans* also consistently contains atranorin in addition to usnic acid, the overlap areas of which give a peculiar purple colour on TLC plates after acid and heat treatment. This purple colour is similar to that given by some terpenes, but the purple colour is only produced in the overlap zones of atranorin and usnic acid, which seems to indicate that a terpene is not present. *Parmelia adligans* also lacks hypostictic acid and unknown PQ-4, present in *P. adhaerens*, and contains an additional unidentified substance, not present in *P. adhaerens*. Krog & Swinscow (1987) have confirmed the presence of hypostictic acid and unknown PQ-4 in *P. adhaerens*. Both *P. adhaerens* Nyl. and *P. adligans* Brusse sometimes contain another unidentified substance related to stictic acid, which is present in large amounts in the holotype specimen of *Parmelia steineri* Gyeln. (P.A. v.d. Bijl 1141, W) which is a synonym of *P. molliuscula* Ach. This substance may be methylstictic acid (Shimada *et al*. 1980).

The apothecia of *P. adhaerens* are adnate, whereas those of *P. adligans* are usually immersed in the central areoles.

Parmelia adligans is a common species in southern Africa on the eastern side, and also extends along the mountains into the south-western Cape.

Additional specimens examined. SOUTH AFRICA, TRANSVAAL—**2527** (Rustenburg): Div. Krugersdorp, Magaliesberg, Retiefskloof, S. of Rustenburg, on quartz rocks near waterfall, exposed ± 1 500 m alt. (–CD). *R.A. Maas Geesteranus*, 7.11.1949 (Almborn, Lichenes Africani 6497; LD, PRE). **2528** (Pretoria): Pretoria Botanical Garden, Silverton Ridge, on quartzite on ridge top, common on all aspects, alt. 1 350 m (–CB). *F. Brusse 2001*, 20.viii.1980 (BM, COLO, LD, PRE); Pretoria, Constantia Park water tower, on rocks on NE slope, alt. 1 560 m (–CD). *F. Brusse 4956*, 26.ii.1986 (BM, COLO, PRE); Pretoria, Donkerpoort, on sandstone (–DC). *E.M. Doidge CH4583*, iii.1943. **2529** (Witbank): Middelburg, koppie just W of the town (1 km NW of town centre, on road to township; 25°46'S; 29°26,5'E), on E sides of Waterberg sandstone exposures on gentle NE slope, alt. 1 500 m (–CD). *F. Brusse 1304*, 27.iii.1981 (COLO, PRE). **2530** (Lydenburg): Summit of Long Tom Pass between Sabie and Lydenburg, on gentle NW slope with small sandstone boulders, on sandstone, alt. 2 150 m (–BA). *F. Brusse 4479*, 16.i.1986 (BM, COLO, LD, PRE); Mac Mac Falls on Sabie River, SW of Sabie, on W top of gorge just downstream from falls, on top of low sandstone outcrop, in full sun, alt. 1 300 m (–BB). *F. Brusse 4492*, 16.i.1986 (LD, PRE).

CAPE PROVINCE—**3320** (Montagu): 7 km S of Winery at Barrydale, Tradouw Pass, Langeberg range, on TMS on steep S slope, alt. 350 m (–DC). *F. Brusse 3667*, 11.v.1981 (COLO, PRE). **3321** (Ladismith): 8,6 km NW of Amalienstein, near Ladismith, Seven Weeks Poort, on bouldered W slope, on TMS boulders, alt. 670 m (–AD). *F. Brusse 4934*, 10.ii.1986 (COLO, LD, PRE).

PARMELIA ARQUATA Brusse, *sp. nov.*

Thallus crustosus et effiguratus, saxicola, ad 4 cm diametro. *Lobi* elongati, 1–4,5 mm longi, 0,2–1,0 mm lati, 100–270 µm crassi. *Thallus superne* viridis, opacus vel ad apices loborum grosse pruinosus, emaculatus, isidiis sorediisque destitutus. *Cortex superior* 10–15 µm crassus. *Stratum gonidiale* 20–80 µm crassum, algis *Trebouxiis*, 4–20 µm diametris. *Medulla* alba, 30–160 µm crassa. *Cortex inferior* 10–15 µm crassus. *Thallus inferne* ad apices loborum ater. *Rhizinae* non bene evolutae. *Apothecia* immersa, ad 0,8 mm diametris. *Hypothecium* hyalinum, 10–40 µm crassum. *Subhymenium* hyalinum, 10–70 µm profundum, J+ caeruleum. *Hymenium* hyalinum, 35–45 µm altum, J+ caeruleum. *Asci* clavati, cum tholis J+ caeruleis (figura 2). *Ascosporae* octonae, hyalinae, simplices, ellipsoideae, 8–10,5 × 4–6,5 µm. *Pycnidia* globosa, circa 95 µm profunda et circa 85 µm lata. *Pycnidiosporae* hyalinae, bacillares, 5–8,5 × 0,8 µm. *Thallus* atranorinum, acidum usnicum et acidum psoromicum continens.

TYPUS: SOUTH AFRICA, Transvaal, **2628** (Johannesburg): Johannesburg, Linksfield Ridge, on W face of sandstone rock, on steep N slope, rare, alt. 1 780 m (–AA). *F. Brusse 1126*, 15.v.1976 (PRE, holo-; ANUC, BM, COLO, LD, MEL, US, iso-). Figure 5.

Thallus crustose and effigurate, saxicolous, to 4 cm across. *Lobes* elongate, 1–4,5 mm long, 0,2–1,0 mm wide, 100–270 µm thick. *Upper surface* green, matt to coarse pruinose at lobe tips, emaculate, isidia and soredia absent. *Upper cortex* 10–15 µm thick. *Algal layer* 20–80 µm thick, algae *Trebouxia*, 4–20 µm diam. *Medulla* white, 30–160 µm thick. *Lower cortex* 10–15 µm thick. *Lower surface* black at lobe tips. *Rhizines* not well developed. *Apothecia* immersed, to 0,8 mm across. *Hypothecium* hyaline, 10–40 µm thick. *Subhymenium* hyaline, 10–70 µm deep, J+ blue. *Hymenium* hyaline, 35–45 µm high, J+ blue. *Asci* clavate, eight-spored, tholus J+ blue (figure 2).

Ascospores hyaline, monolocular, ellipsoid, 8–10,5 × 4–6,5 µm. *Pycnidia* globose, about 95 µm deep and about 85 µm wide. *Pycnidiospores* hyaline, rods, 5–8,5 × 0,8 µm. *Chemistry*: Atranorin, usnic acid and psoromic acid present.

Etymology: *arquata* (L) = sufferer of jaundice, in allusion to the colour of the medulla in *para*-phenylenediamine solution, due to the presence of psoromic acid.

Parmelia arquata is similar to *P. adligans* in thallus morphology, but is clearly distinct, because of the presence of psoromic acid, rather than stictic acid. Other members of this group have different distributions: *P. insipida* Brusse (evernic acid) occurs from the Sneeuwberg near Graaff-Reinet, to the southern Drakensberg, at Qacha's Nek near Matatiele; *Parmelia leptoplaca* (Zahlbr.) Brusse (salacinic acid) is widespread and common in the central Cape Province and the Little Karoo in Karooid areas; *Parmelia ralla* Brusse (norlobaridone) is present in the Cape fold mountains (Cape floral area) with definite records as far as Uniondale; *Parmelia squamatica* Brusse (squamatic acid) is only known from the Cedarberg near Clanwilliam in the western Cape Province, and *Parmelia adhaerens* Nyl. (hypostictic plus stictic acids), so far only known from the south-western Cape.

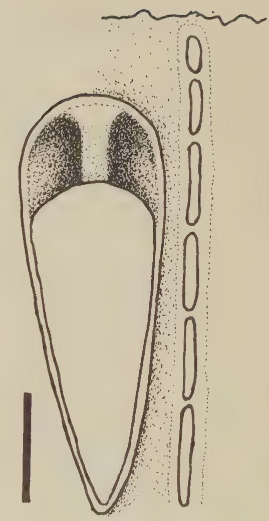

FIGURE 2. — *Parmelia arquata* Brusse, ascus and paraphysis. *F. Brusse 1126*, holotype. Bar = 10 µm.

Other *Xanthoparmeliae* containing psoromic acid are clearly foliose and lack atranorin.

Parmelia arquata is presently only known from the type collection, from Johannesburg in the southern Transvaal.

PARMELIA GANYMEDEA Brusse, *sp. nov.*

Thallus crustosus et effiguratus, saxicola, ad 4 cm diametro. *Lobi* elongati, 0,2–0,8 mm lati, 100–170 µm crassi. *Thallus superne* viridis, opacus vel ad apices loborum grosse pruinosus, emaculatus, pustuli-soraliatus. *Soralia* alba, 0,1–0,3 mm diametris. *Soredia* granularia, 35–80 µm diametris. *Cortex superior* 12–15 µm crassus. *Stratum gonidiale* 20–80 µm crassum, algis *Trebouxiis*, 5–18 µm diametris. *Medulla* alba, 40–100 µm crassa. *Cortex inferior* circa 10 µm crassus. *Thallus inferne* brunneus. *Rhizinae* non bene evolutae. *Apothecia* et *pycnidia* non visa. *Thallus* acidum usnicum et acidum evernicum continens.

TYPUS: SOUTH AFRICA, Transvaal, **2628** (Johannesburg): Johannesburg, Linksfield Ridge, on W face of quartzite rock, on steep N slope, alt. 1 780 m (–AA). *F. Brusse 5089*, 8.xi.1987 (PRE, holo-; BM, COLO, LD, US, iso-). Figure 6.

Thallus crustose and effigurate, saxicolous, to 4 cm across. *Lobes* elongate, 0,2–0,8 mm wide, 100–170 µm thick. *Upper surface* green, matt to coarse pruinose at the lobe tips, emaculate, pustular-soraliate. *Soralia* white, 0,1–0,3 mm across. *Soredia* granular, 35–80 µm diam. *Upper cortex* 12–15 µm thick. *Algal layer* 20–80 µm thick, algae

Trebouxia, 5–18 μm diam. *Medulla* white, 40–100 μm thick. *Lower cortex* around 10 μm thick. *Lower surface* brown. *Rhizines* not well developed. *Apothecia* and *pycnidia* not seen. *Chemistry*: Usnic acid in the upper cortex and evernic acid in the medulla.

Etymology: *ganymedea* (G) = belonging to ganymedes, the cup-bearer of Jove in Greek mythology, in allusion to the cup-shaped scars of spent soralia. Ganymede is also the name of the largest moon of Jupiter, and is visible with small telescopes.

This new species is quite unique amongst the crustose *Xanthoparmeliae*, in having small pustular soralia, which are granular sorediate. The only close species is the Cape lichen, *Parmelia (Xanthoparmelia eruptens* Hale), which although small itself, is a foliose lichen with a shiny upper surface, with dactyls up to 0,5 mm wide. The dactyls do not become sorediate, but are warty, fragile and subpustular. The lichen is reported to contain lecanoric acid in addition to evernic acid in the medulla (Hale 1987), whereas *P. ganymedea* contains only evernic acid in this region.

Thus far, *Parmelia ganymedea*, is known only from the type gathering, from Johannesburg in the southern Transvaal.

PARMELIA SIGILLATA Brusse, *sp. nov.*

Thallus foliosus, saxicola, sat adnatus, ad 4 cm diametro. *Lobi* elongati, 1–3 mm lati, 85–200 μm crassi. *Thallus superne* viridis, nitidus, reticulate maculatus, isidiis sorediisque destitutus. *Cortex superior* 7–11 μm crassus, paraplectenchymatus. *Stratum gonidiale* 20–60 μm crassum, algis *Trebouxiis*, 4,5–16 μm diametris. *Medulla* alba, 30–140 μm crassa. *Cortex inferior* 6–8 μm crassus. *Thallus inferne* pallide brunneus. *Rhizinae* sat numerosae, 25–80 μm crassae, simplices. *Apothecia* adnata, ad 2,5 mm diametris. *Hypothecium* hyalinum, 15–40 μm crassum. *Subhymenium* hyalinum, 10–15 μm crassum, J+ pallide caeruleum. *Hymenium* hyalinum, 35–45 μm altum, J+ caeruleum. *Asci* clavati, cum tholis J+ caeruleum (figure 3). *Ascosporae* octonae, hyalinae, simplices, ellipsoideae, 8–11,5 × 5–6,5 μm. *Pycnidia* 100–120 μm profunda, 70–110 μm lata. *Pycnidiosporae* hyalinae, bacillares, 4,5–8,5 × 0,8 μm.

TYPUS: SOUTH AFRICA, CAPE PROVINCE—**3322** (Oudtshoorn): 9 km N of De Rust, Meiringspoort, on TMS outcrops on steep SW slope, alt. 550 m (–BC). *F. Brusse 4827*, 5.ii.1986 (PRE, holo-; BM, iso-). Figure 7.

Thallus foliose, saxicolous, moderately adnate, to 4 cm across. *Lobes* elongate, 1–3 mm wide, 85–200 μm thick. *Upper surface* green, nitid, reticulately maculate, isidia and soredia absent. *Upper cortex* 7–11 μm thick, paraplectenchymatous. *Algal layer* 20–60 μm thick, algae *Trebouxia*, 4,5–16 μm diam. *Medulla* white, 30–140 μm thick. *Lower cortex* 6–8 μm thick. *Lower surface* pale brown. *Rhizines* moderately numerous, simple, 25–80 μm thick. *Apothecia* adnate, to 2,5 mm across. *Hypothecium* hyaline, 15–40 μm thick. *Subhymenium* hyaline, 10–15 μm thick, J+ pale blue. *Hymenium* hyaline, 35–45 μm high, J+ blue. *Asci* clavate, eight-spored, tholus J+ blue (figure 3). *Ascospores* hyaline, monolocular, ellipsoid, 8–11,5 × 5–6,5 μm. *Pycnidia* globose, 100–120 μm deep, 70–110 μm wide. *Pycnidiospores* hyaline, rods, 4,5–8,5 × 0,8 μm.

Etymology: *sigillata* (L) = spotted or blotched like a seal, in allusion to the reticulately maculate upper surface.

Parmelia sigillata is an unusual *Xanthoparmelia* in that the upper surface is reticulately maculate, and the upper cortex is more paraplectenchymatous than is usual for this section. These characteristics are indicative of the *Parmelia saxatilis* group, but this is probably a distinct genus because of the presence of a syncortex (i.e. a mucopolysaccharide matrix embedding the upper cortex which is soluble in hyaluronidase (Modenesi & Vanzo 1986)). *P. sigillata* is epicorticate (i.e. has a polysaccharide layer on top of the upper cortex, which although not tested, would probably be insoluble in hyaluronidase, like that of *P. caperata*, tested by Modenesi & Vanzo (1986)).

Other maculate species in *Xanthoparmelia*, are effigurately maculate, and species containing closely related substances, such as *Parmelia dysprosa* (Brusse & Knox) Brusse (1984) and *Parmelia (Xanthoparmelia protodysprosa* Hale (1987)) are black below, not pale brown as in *P. sigillata.*

Parmelia sigillata may also be related to *P. worcesteri* Stnr. & Zahlbr. (Zahlbruckner 1926), but the latter is emaculate and contains lecanoric acid only, without any evernic acid.

At present this species is known only from the type locality, Meiringspoort, in the Great Swartberg mountains just north of the village of De Rust.

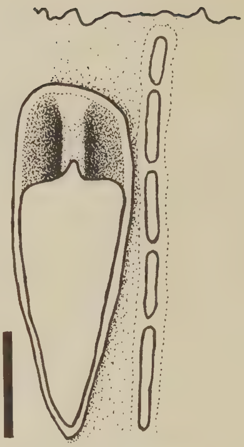

FIGURE 3.—*Parmelia sigillata* Brusse, ascus and paraphysis. *F. Brusse 4827*, holotype. Bar = 10 μm.

PARMELIA VERECUNDA Brusse, *sp. nov.*

Thallus foliosus, saxicola, sat adnatus, ad 3 cm diametro. *Lobi* elongati, imbricati, 0,1–1,2 mm lati, 90–260 μm crassi. *Thallus superne* viridis, nitidus, emaculatus, reticulate-foveatus, isidiis sorediisque destitutus. *Cortex superior* 10–15 μm crassus, paraplectenchymatus. *Stratum gonidiale* 20–40 μm crassum, algis *Trebouxiis*, 6–15 μm diametris. *Medulla* crocea, 30–180 μm crassa. *Cortex inferior* 8–10 μm crassus. *Thallus inferne* piceus. *Rhizinae* simplices, 45–65 μm crassae. *Apothecia* et *pycnidia* non visa. *Thallus* acidum usnicum, acidum secalonicum A et materiam ignotam continens.

TYPUS: SOUTH AFRICA, CAPE PROVINCE.—**3322** (Oudtshoorn): 10 km from George to Oudtshoorn, Outeniqua Pass, Outeniqua mountains, on TMS outcrop on steep S slope, in semi-shade of trees, alt. 790 m (–CD). *F. Brusse 4790*, 3.ii.1986 (PRE, holo-; BM, COLO, iso-). Figure 8.

Thallus foliose, saxicolous, moderately adnate, to 3 cm across. *Lobes* elongate, imbricate 0,1–1,2 mm wide, 90–260 μm thick. *Upper surface* green, nitid, emaculate, reticulately foveate, isidia and soredia absent. *Upper cortex* 10–15 μm thick, paraplectenchymatous. *Algal layer* 20–40 μm thick, algae *Trebouxia*, 6–15 μm diam. *Medulla* dirty orange, 30–180 μm thick. *Lower cortex* 8–10 μm thick. *Lower surface* black. *Rhizines* simple, 45–65 μm thick. *Apothecia* and *pycnidia* not seen. *Chemistry*: Usnic acid in the upper cortex, secalonic acid A and an unknown substance (possibly the same unknown as in *Parmelia brunnthaleri* Stnr. & Zahlbr.) in the medulla.

Etymology: *verecunda* (L) = modest, indicating the modest size of this lichen.

This new species has no close relatives, but should the unknown substance by the same unknown as in *Parmelia brunnthaleri* Stnr. & Zahlbr. (Zahlbruckner 1926), then it may be a relative of that species. However, *P. brunnthaleri* lacks the pigment, is pale brown below and is a typical karoo lichen, occurring in the central areas of the Cape Province and in the Little Karoo, in short arid open shrubland, which typifies Karooid vegetation. *P. verecunda* occurs on the seaward slopes of the Outeniqua mountains, in mediterranean sclerophyllous vegetation, locally known as fynbos. These slopes receive much rain and mist all the year round and the two habitats are very different.

At present this new species is known only from the type locality, in the Outeniqua mountains near George, in the southern Cape Province.

NEW COMBINATIONS

Parmelia capicola Brusse, *nom. nov.*

Basionym: *Xanthoparmelia capensis* Hale, Mycotaxon **27**: 567. 1986. (non *Parmelia capensis* Ach. Method. Lich.: 269. 1803).

Parmelia ceresensis (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia ceresensis* Hale, Mycotaxon **27**: 568. 1986.

Parmelia diacida (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia diacida* Hale, Mycotaxon **27**: 572. 1986.

Parmelia endochromatica (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia endochromatica* Hale, Mycotaxon **27**: 574. 1986.

Parmelia gyrophorica (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia gyrophorica* Hale, Mycotaxon **27**: 578. 1986.

Parmelia lesothoensis (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia lesothoensis* Hale, Mycotaxon **27**: 582. 1986.

Parmelia ochropulchra (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia ochropulchra* Hale, Mycotaxon **27**: 590. 1986.

Synonym: *Xanthoparmelia duplicata* Hale, Mycotaxon **27**: 572 (non *Parmelia duplicata* Ach. Method. Lich.: 252. 1803).

Parmelia rogersii (Elix & Jen Johnston) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia rogersii* Elix & Jen Johnston, Bull. Br. Mus. nat. Hist. (Bot.) **15**(3): 317. 1986.

Synonym: *Xanthoparmelia viridis* Hale, Mycotaxon **27**: 609. 1986. (non *Parmelia viridis* Spreng., Syst. Veget. **4**(1): 294. 1827; nec *Parmelia viridis* Mont., Sylloge Gen. Sp. Crypt.: 329. 1856).

Parmelia stenosporonica (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia stenosporonica* Hale, Mycotaxon **27**: 598. 1986.

Parmelia thamnolica (Hale) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia thamnolica* Hale, Mycotaxon **27**: 604. 1986.

Parmelia transvaalensis (Hale, Nash & Elix) Brusse, *comb. nov.*

Basionym: *Xanthoparmelia transvaalensis* Hale, Nash & Elix in Hale, Mycotaxon **27**: 606. 1986.

Parmelia xanthomelanoides (Elix & Nash) Brusse, *comb. nov.*

Basionym: *Paraparmelia xanthomelanoides* Elix & Nash in Nash & Elix, Mycotaxon **29**: 469. 1987.

Porpidia corralensis (Raes.) Brusse, *comb. nov.*

Basionym: *Lecidea corralensis* Raes., Revista Univ. (Santiago) **22**: 211. 1937. Hertel, Herzogia **2**: 40. 1970.

Synonym: *Poeltiaria corralensis* (Raes.) Hertel, Beih. Nova Hedwigia **79**: 431. 1984.

NEW RECORDS

Acarospora bella (Nyl.) Jatta

SOUTH WEST AFRICA/NAMIBIA.—**2615** (Luderitz): Haalenberg summit, east of Luderitz, on rock (–CB). *G. Williamson 2852*, 1980 (PRE).

Arthonia mira R. Sant.

SOUTH AFRICA, CAPE PROVINCE.—**3423** (Knysna): Knysna, C.P., on *Cassine crocea* leaves (–AA). *A.M. Bottomley 1631*, 23.iv.1939, det. R. Santesson (COLO, LD, PRE).

Arthonia trilocularis Müll. Arg.

SOUTH AFRICA, NATAL.—**2930** (Pietermaritzburg): Buccleugh near Cramond (–AD). *E.M. Doidge 269* (on *Podocarpus falcatus* leaves) & *272* (on *Behnia reticulata* leaves), 17.vii.1918, det. R. Santesson 1954 (PRE).

CAPE PROVINCE.—**3423** (Knysna): Knysna, C.P., on *Cassine crocea* leaves (–AA). *A.M. Bottomley 1631a*, 23.iv.1939, det. R. Santesson (PRE).

Arthrorhaphis citrinella (Ach.) Poelt

SOUTH AFRICA, NATAL.—**2828** (Bethlehem): 31 km S of Phuthaditjhaba (Witsieshoek), Mont-aux-Sources, summit of Western Buttress, summit plateau, on small soil bank with SE aspect, on gentle S slope, on blue-green algal pellicles on soil, with mosses, alt. 3080 m (–DB). *F. Brusse 4515*, 21.i.1986 (BM, LD, PRE). Lit. Galloway & Bartlett (1986).

Asterothyrium rotuliforme (Müll. Arg.) Serusiaux

SOUTH AFRICA, NATAL.—**3030** (Port Shepstone): Umtentwini, on *Lichi chinensis* leaves (–CB). *H. Porter 1709*, 30.xii.1940, det. R. Santesson 1954 (PRE).

TRANSKEI.—**3228** (Butterworth): Xoposa, on *Citrus aurantium* leaves (–AC). *J. Mac Muir 265*, 12.iii.1915, det. R. Santesson 1954 (PRE).

Aulaxina dictyospora R. Sant.

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Pietersburg district, Serala Wilderness Area, forest on E slope of Mt. Serala, on leaves of *Chionanthes foveolata* in deep shade of tall forest (–AA). *F. Venter 10494a*, 19.i.1985 (PRE).

Aulaxina quadrangula (Stirt.) R. Sant.

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Pietersburg district, Serala Wilderness Area, forest on E slope of Mt. Serala, on leaves of *Chionanthes foveolata* in deep shade of tall forest (–AA). *F. Venter 10494b*, 29.i.1985 (PRE); Pilgrim's Rest, on leaves of *Syzygium guineense* (–DD). *F. Venter 10577b*, 20.ii.1985 (PRE).

NATAL.—**3030** (Port Shepstone): Umtentweni, on *Lichi sinensis* leaves (–CB). *H. Porter 1708*, 30.xii.1940, det. R. Santesson 1954 (PRE).

Byssoloma subdiscordans (Nyl.) P. James

SOUTH AFRICA, TRANSVAAL.—**2329** (Pietersburg): Louis Trichardt, on leaves of *Syncarpia laurifolia* (–BB). *District Forest Officer 2150a, 2151*, 6.ix.1938 (PRE). **2430** (Pilgrim's Rest): Pietersburg district, Serala Wilderness Area, near Serala Peak, on leaves of *Carissa bispinosa*, in deep shade (–AA). *F. Venter 10496*, 30.i.1985 (PRE); Pilgrim's Rest, alt. 1570 m (–DD). *F. Venter 10573c* (on *Maytenus undata* leaves), *10576b* (on leaves of *Peddiea africana*), 20.ii.1985 (PRE).

Calopadia fusca (Müll. Arg.) Vezda

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Pilgrim's Rest, alt. 1 570 m (–DD). *F. Venter 10573a* (on *Maytenus undata* leaves), *10576a* (on leaves of *Peddiea africana*), 20.ii.1985 (PRE).

NATAL.—**2831** (Nkandla): Eshowe, on *Cola natalensis* leaves (–CD). *J. Gerstner 1966*, det. R. Santesson 1954 (PRE).

Calopadia puiggarii (Müll. Arg.) Vezda

SOUTH AFRICA, NATAL.—**2832** (Mtubatuba): Hlabisa, Dukuduku Farm no. 175, on *Dracaena* leaves in forest (–AD). *R.G. Strey 4711* (5608b), 23.xi.1964 (PRE). **2930** (Pietermaritzburg): Inanda, on leaves of tea plant (*Thea viridis*) (–DB). *J.M. Wood 4*, 1877–78, det. R. Santesson 1954 (PRE).

Candelariella coralliza (Nyl.) H. Magn.

SOUTH AFRICA, CAPE PROVINCE.—**3219** (Wuppertal): Pakhuisberg in the Clanwilliam area, top of Pakhuis Pass, on S TMS faces on moderate bouldered slope, 850–1 000 m (–AA). *F. Brusse 3132*, 3.v.1981 (PRE). **3220** (Sutherland): 34 km N of Matjiesfontein, Turck's Pass, on S side of prominent dolerite rock, on W kranz, rare, alt. 1 200–1 235 m (–DC). *F. Brusse 1072*, 4.ii.1977 (PRE).

Cladonia fuscocinerea Ahti

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Mount Sheba near Pilgrim's Rest, scattered boulders on S slope near mountain top (–DC). *Nancy Slack s.n.*, 15.i.1986 (PRE); Mount Sheba near Pilgrim's Rest, sandstone outcrops and boulders called 'The Lost City', S slope, on soil at S bases of boulders in semi-shade of *Erica* shrubs. Clumps grow up to 30 cm in diameter. Alt. 1 850 m (–DC). *F. Brusse 5003*, 17.iv.1987 (B, BM, CBG, COLO, E, LD, LG, MEL, PRE, S, UC, UPS, US).

Cladonia hedbergii Ahti

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Mount Sheba near Pilgrim's Rest, sandstone outcrops and boulders called 'The Lost City', S slope, on soil at S bases of boulders, in more exposed positions than *Cladonia fuscocinerea*, and thallus shorter and browner. Thallus clumps up to one meter across. Alt. 1 850 m (–DC). *F. Brusse 5004*, 17.iv.1987 (BM, COLO, LD, PRE, UC, UPS).

CAPE PROVINCE.—**3321** (Ladismith): Garcia's Pass (–CC). *J. Muir 3767*, 4.ix.1925 (PRE); 17 km N of Riversdale, Garcia's Pass, SW side of Kareekop, on the Langeberg, on soil near rock on steep S slope, alt. 500–600 m (–CC). *F. Brusse 3603*, 10.v.1981 (COLO, PRE). **3322** (Oudtshoorn): 10 km from George to Oudtshoorn, Outeniqua mountains, Outeniqua Pass, on soil between rocks in semi-shade, on steep S slope, alt. 790 m (–CD). *F. Brusse 4788*, 3.ii.1986 (BM, COLO, PRE).

Coccocarpia palmicola (Spreng.) Arvidss. & D. Gallow.

SOUTH AFRICA, TRANSVAAL.—**2530** (Lydenburg) Mac Mac Falls, W of Sabi, on W top gorge just downstream from the falls, on level sandstone over mosses, in shade of shrubs and trees, alt. 1 300 m (–BB). *F. Brusse 4495*, 16.i.1986 (PRE). Lit. Arvidsson (1982).

Coenogonium moniliforme Tuck.

SOUTH AFRICA, TRANSVAAL.—**2329** (Pietersburg): District Soutpansberg, 13 km NE of Soekmekaar, on *Dombeya rotundifolia*, alt. 1 100 m (–BD). *F. Brusse 1659*, 23–29.i.1981 (PRE).

Dimerella zonata (Müll. Arg.) R. Sant.

SOUTH AFRICA, NATAL.—**2831** (Nkandla): Eshowe on *Cola natalensis* leaves (–CD). *J. Gerstner 1963*, det. R. Santesson 1954 (PRE).

Dirinaria flava (Müll. Arg.) Dodge

SOUTH AFRICA, TRANSVAAL.—**2231** (Pafuri): Kruger National Park, Punda Maria ridge, on bark of *Holarrhena febrifuga* (–CA). *A.M. Brynard 4059*, 11.viii.1959 (COLO, LD, PRE).

NATAL.—**3030** (Port Shepstone): Oribi Gorge near Port Shepstone, on branches of a dead *Tarchonanthus trilobus* tree, in shade of a TMS overhang (–CA). *F. Brusse 1482*, 27.xii.1978 (PRE). Lit. Awasthi (1975).

Echinoplaca epiphylla Fée

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Pietersburg district, Serala Wilderness area, near Serala Peak, on leaves of *Scolopia mundii* in deep shade (–AA). *F. Venter 10497*, 30.i.1985 (PRE); Pilgrim's Rest, on *Maytenus undata* leaves alt. 1570 m (–DD). *F. Venter 10573e*, 20.ii.1985 (PRE).

Echinoplaca pellicula (Müll. Arg.) R. Sant.

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Pilgrim's Rest, on leaves of *Oxyanthus gerrardii*, alt. 1 570 m (–DD). *F. Venter 10575*, 20.ii.1985 (PRE).

Heterodermia comosa (Eschw.) Follm. & Redon

SOUTH AFRICA, TRANSVAAL.—**2329** (Pietersburg): 4 km NNE of Soekmekaar, farm Excelsior 521, on *Dombeya rotundifolia*, alt. 1 200 m (–BD). *F. Brusse 1670*, 23–29.i.1981 (PRE).

Heterodermia dactyliza (Nyl.) Swinsc. & Krog

SOUTH AFRICA, TRANSVAAL.—**2530** (Lydenburg): Mac Mac Falls, W of Sabi, on W top of gorge just downstream from the falls, on S and E faces of sandstone outcrops, in semi-shade, loosely attached, alt. 1 300 m (–BB). *F. Brusse 4493*, 16.i.1986 (COLO, PRE).

Heterodermia erinacea (Ach.) W. Weber

SOUTH AFRICA, CAPE PROVINCE.—**2917** (Springbok): 1,5 km towards Kleinsee from t.o. from Port Nolloth–Steinkopf road, on various dead and dying shrubs, alt. c. 100 m (–AC). *H. Glen 1438*, 29.viii.1985 (COLO, LD, PRE). This lichen was previously only known from western North America, from a similar submediterranean coastal desert.

Heterodermia flabellata (Fée) Awast.

SOUTH AFRICA, NATAL.—**2832** (Mtubatuba): Hlabisa, Palm Ridge Farm, coastal sandflats, scrub with scattered trees, occurs on bark of trees, alt. 60 m (–AC). *E.R. Harrison 470*, 30.iv.1968 (COLO, LD, PRE). **3030** (Port Shepstone): Umtamvuna Nature Reserve, Devil's Backbone, on rock in short forest, alt. 300 m (–CC). *A. Abbott 1768*, 23.02.1984 (PRE).

CAPE PROVINCE.—**3227** (Stutterheim): Pirie Forest, on bark (–CB). *E. Schaefer 2047*, iii.1944, det. S. Kurokawa 1962 (PRE).

Heterodermia lepidota Swinsc. & Krog

SOUTH AFRICA, NATAL.—**3029** (Kokstad): Mount Currie district, Dassiekop (Trig. beacon 135; 30°28'S, 29°20,5'E), on coarse grained dolerite, in partial shade, alt. 1 880 m (–AD). *F. Brusse 1167*, 30.xii.1977 (PRE).

Heterodermia lutescens (Kurok.) Follm.

SOUTH AFRICA, NATAL.—**3030** (Port Shepstone): Oribi Gorge near Port Shepstone, on TMS (–CA). *F. Brusse 1488*, 27.xii.1978 (PRE). **3130** (Port Edward): Port Edward, Ka-inSizizi location, on rocks (–AA). *C.H. Stirton 5697*, 25.x.1975 (PRE).

Heterodermia microphylla (Kurok.) Swinsc. & Krog

SOUTH AFRICA, NATAL.—**2930** (Pietermaritzburg): Pietermaritzburg, Everton, on tree in natural forest (–DD). *C.H. Stirton 5500*, 23.x.1975 (PRE).

Heterodermia obscurata (Nyl.) Trev.

SOUTH AFRICA, CAPE PROVINCE.—**3323** (Willowmore): Knysna district, Blauwkrantz, on oaks (*Q. pedunculata*) in open situation at the forester's house (–DC). *O.A. Hoeg s.n.*, 21.vi.1929, det. S. Kurokawa 1969 (PRE, TRH). No specimens have been cited for South Africa previously, and therefore this species has not been validly recorded for this area up until now.

Heterodermia pseudospeciosa (Kurok.) Culb.

SWAZILAND.—**2631** (Mbabane): Ezulwini Valley, S of Mbabane, Mantenga Falls, on the Little Usutu River, on bark, alt. 770 m (–AC). *F. Brusse 1131*, 1.v.1976 PRE).

Lecanora epibryon (Ach.) Ach.

SOUTH AFRICA, CAPE PROVINCE.—**3319** (Calvinia): Ceres District, Gydo Pass, on vertical low mossy soil bank, in shade of bushes, on steep SW slope, alt. 1 000 m (–AB). *F. Brusse 2612*, 27.iv.1981 (PRE).

Lecanora gangaleoides Nyl.

SOUTH AFRICA, NATAL.—**2829** (Harrismith): Cathederal Peak Nature Reserve, Doreen Falls on the mLambonja River, tree cluster around boulder cluster near lower falls, on rock in tree shade, alt. 1 680 m (–CC). *F. Brusse 4532*, 22.i.1986 (LD, PRE).

Lepraria incana (L.) Ach.

SOUTH AFRICA, TRANSVAAL.—**2628** (Johannesburg): Johannesburg, Linksfield Ridge, on soil under rock, in rock shade, on N facing slopes (–AA). *F. Brusse 1142*, 16.iv.1978 (PRE).

ORANGE FREE STATE.—**2827** (Senekal): 18 km E of Marquard, De Hoek farm on Clarens sandstone (–CB). *D. Venter 4505*, 18.iv.1979 (PRE).

Parmelia (Bulbothrix) sensibilis Stnr. & Zahlbr.

SOUTH AFRICA, TRANSVAAL.—**2329** (Pietersburg): Soutpansberg district, 10 km from Louis Trichardt to Vivo, on *Sclerocarya caffra* bark, alt. 1 000 m (–BB). *F. Brusse 1589*, 23–29.i.1981 (PRE).

Parmelia (Flavopunctelia) flaventior Stirt.

SOUTH AFRICA, ORANGE FREE STATE.—**2828** (Bethlehem): Clarens, on bark of *Prunus persica* (–CB). *J.E. v.d. Plank 4442*, vii.1943, det. M.E. Hale (COLO, LD, NU, PRE). **2829** (Harrismith): Farm Rensburgskop near Swinburne, on bark (–DC). *M.L. Jacobsz 5006*, xi.1978 (PRE). No specimens have been cited for this species from South Africa, and therefore no valid record exists.

Parmelia (Flavopunctelia) soredica Nyl.

SOUTH WEST AFRICA/NAMIBIA.—**2217** (Windhoek): Windhoek, Administrasie tuine, op bas van *Jacaranda* (–CA). *A.J. Gous 4552*, vii. 1968 (PRE).

SOUTH AFRICA, TRANSVAAL.—**2528** (Pretoria): Pretoria Botanical Gardens, Silverton Ridge, on *Ochna pulchra* bark (–CB). *F. Brusse 2037*, 4.xi.1980 (LD, PRE).

2628 (Johannesburg): Johannesburg, Linksfield Ridge, common on tree bark (–AA). *F. Brusse 1136*, 26.vi.1976 (LD, PRE). This species is common on the highveld, growing on both indigenous and introduced trees. There is no effectively published citation of a specimen available, although Hale (1980) published distribution maps with dot records for South Africa.

Parmelia (Hypotrachyna) degelii Hale

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Mount Sheba near Pilgrim's Rest, scattered sandstone boulders on S slope, near top of mountain, on S side of boulder in full sun, alt. 1 850 m (–DC). *F. Brusse 4464*, 15.i.1986 (LD, PRE).

Parmelia (Hypotrachyna) densirhizinata Kurok.

SOUTH AFRICA, TRANSVAAL.—**2329** (Pietersburg): Soutpansberg approximately 50 km W of Louis Trichardt, summit of mountain range on farm Ottosdal, rocky quartzite and sandstone terrain on S edge of summit, on *Bequaertiodendron magaliesmontanum* bark, alt. 1 430 m (–AB). *F. Brusse 4433*, 13.i.1986 (PRE).

Parmelia (Hypotrachyna) erythrodes (Zahlbr.) Hale & Kurok.

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Mount Sheba near Pilgrim's Rest, scattered sandstone boulders on S slope, near top of mountain, on S rock face in semi-shade (–DC). *F. Brusse 4468*, 15.i.1986 (PRE).

Parmelia (Hypotrachyna) imbricatula Zahlbr.

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Mount Sheba near Pilgrim's Rest, scattered sandstone boulders on S slope, near top of mountain, on SE boulder face, alt. 1 850 m (–DC). *F. Brusse 4477*, 15.i.1986 (LD, PRE).

Parmelia (Neofuscelia) parviloba Essl.

SOUTH AFRICA, CAPE PROVINCE.—**3322** (Oudtshoorn): 19 km S of Prince Albert, summit of Swartberg Pass, windblown SE gulley on S faces of TMS rock, alt. 1 650 m (–AC). *F. Brusse 4892*, 7.ii.1986 (BM, COLO, LD, PRE) & *F. Brusse 4879*, 6.ii.1986 (PRE).

Parmelia (Parmelia) kerguelensis F. Wils.

SOUTH AFRICA, CAPE PROVINCE.—**3319** (Worcester): 15 km E of Wellington, Bains Kloof, White river valley, on the lower S slopes of Limietkop, on SW faces of large TMS outcrop near road, alt. 600 m (–CA). *F. Brusse 2590*, 26.iv.1981 (LD, PRE).

Parmelia (Parmotrema) mellissii Dodge

SOUTH AFRICA, NATAL.—**3029** (Kokstad): Weza Forest, on horizontal branch, shaded (–DC). *C.H. Stirton 10410*, 17.12.1981 (PRE).

Parmelia (Parmotrema) usambarensis Stnr. & Zahlbr.

SOUTH AFRICA, NATAL.—**2929** (Underberg): 65 km SW of Estcourt, Giant's Castle Game Reserve, about half-way along Giant's Hut trail, along umChezi (Bushman's) river, boulder cluster near river, on E Clarens (Cave) sandstone boulder face in full sun, alt. 1 950 m (–BC). *F. Brusse 4552*, 23.i.1986 (BM, COLO, LD, PRE).

Parmelia (Xanthoparmelia) burmeisteri Elix

SOUTH AFRICA, CAPE PROVINCE.—**3321** (Ladismith): Seven Weeks Poort, about 16½ km from the main Calitzdorp–Ladismith road, on large TMS boulders in the cove of a high water trickle (waterfall), alt. 950 m (–AD). *F. Brusse 3566*, 9.v.1981 (BM, LD, PRE). **3322** (Oudtshoorn): 19 km S of Prince Albert, top of Swartberg Pass, on TMS, on steep S slope, alt. 1 600 m (–AC). *F. Brusse 3461*, 7.v.1981 (BM, COLO, LD, PRE).

Parmelia (Xanthoparmelia) conspersa Ach.

SOUTH AFRICA, CAPE PROVINCE.—**3218** (Clanwilliam): 3 km W of Olyvenboskraal, Witelskloof, on large TMS boulder outcrop, alt. 500 m (–BD). *F. Brusse 3088*, 2.v.1981 (PRE); Half-way up Versveld Pass near Piketberg, on TMS rocks on ledges of E facing cliffs, semishaded, alt. 500 m (–DC). *F. Brusse 2950*, 1.v.1981 (PRE). This species has previously not been correctly reported for South Africa.

Parmelia (Xanthoparmelia) filarszkyana Gyeln.

SOUTH AFRICA, CAPE PROVINCE.—**3220** (Sutherland): Roggeveld Mountains, Ouberg Pass, low Kranz on steep SW slope, on mudstone, alt. 1 400 m (–AD). *F. Brusse 3290*, 5.v.1981 (PRE).

Parmelia (Xanthoparmelia) nigropsoromifera Nash

SOUTH WEST AFRICA/NAMIBIA.—**2017** (Waterberg): Waterberg plateau, rock outcrops or low rocky hills, on sandstone (–AD). *F. Brusse 4248*, 23.iii.1984 (COLO, LD, PRE).

SOUTH AFRICA, CAPE PROVINCE.—**3220** (Sutherland): Roggeveld Mountains, about 30 km SW of Middelpos, near bottom of Gannaga Pass, on large dolerite boulder-outcrop on steep S slope, alt. 800 m (–AA). *F. Brusse 3267*, 5.v.1981 (CBG, COLO, LD, PRE).

Parmelia (Xanthoparmelia) psoromifera Kurok.

SOUTH AFRICA, CAPE PROVINCE.—**2917** (Springbok): On top of Spektakelberg, Springbok, on rock (–AD). *J.J.M. v.d. Merwe 247*, 9.ix.1970 (PRE). **3219** (Wuppertal): Clanwilliam district, upper Biedouw valley, 1 km S of Mertenhof, on low TMS kranzes on a gentle N facing slope (–AA). *F. Brusse 3166*, 3.v.1981 (PRE). **3221** (Merweville): 40 km E of Sutherland, Die Poort se Nek, on a low S to SE mudstone kranz on a low ridge in gentle terrain, alt. 1 400 m (–AC). *F. Brusse 3371*, 6.v.1981 (PRE).

Parmelia (Xanthoparmelia) scabrosa Tayl.

SOUTH WEST AFRICA/NAMIBIA.—**2017** (Waterberg): Südwesafrika, Wasserberg bei Windhoek, auf Schiefer (–AC), *Fincke* (W 3787, on holotype of *Lecanora placodina* Zahlbr.).

SOUTH AFRICA, CAPE PROVINCE.—**2820** (Kakamas): 86 km WNW of Upington, on granitic rock, alt. 760–920 m (–AD). *F. Brusse 772 1-3-1* (J). **2821** (Upington): 10 km SSE of Keimoes, on granite, alt. 760–920 m (–CC). *F. Brusse 768 8-6-3* (J).

Phyllopsora haemophaea (Nyl.) Müll. Arg.

SOUTH AFRICA, NATAL.—**3029** (Kokstad): inGeli forest near Harding, on tree trunk in permanent shade (–DA). *F. Brusse 1846*, 9.i.1982 (LD, PRE). Lit. Swinscow & Krog (1981).

Physcia dubia (Hoffm.) Lett.

SOUTH AFRICA, CAPE PROVINCE.—**3218** (Clanwilliam): Top of Versveld Pass near Piketberg, on TMS boulders on W aspect, alt. 600 m (–DC). *F. Brusse 2999*, 1.v.1981, (BM, LD, PRE). **3318** (Cape Town): Bothmaskloof Pass near Riebeeks Kasteel, Porseleinberg, on TMS outcrops on a NW slope, alt. 350 m (–BD). *F. Brusse 2774*, 28.iv.1981 (PRE).

Physcia tribacia (Ach.) Nyl.

SOUTH AFRICA, NATAL.—**2929** (Underberg): 30 km NE of Underberg, about 2 km from RSA border post at Sani Pass, umKomanazana river valley, hill with boulders and trees. On rock on N slope in semi-shade of trees (–CB). *F. Brusse 4570*, 24.i.1986

(PRE). **3029** (Kokstad): Mount Currie district, 18 km NW of Kokstad, farm Weltevrede, S kranz near the Droewig river (20°28.8'S; 29°18.1'E), on light blue-grey mudstone, alt. 1 480 m (–AD). *F. Brusse 1166*, 1.i.1978 (PRE).

CAPE PROVINCE.—**3218** (Clanwilliam): 3 km W of Olyvenboskraal, Witelskloof, on large TMS boulder outcrop, alt. 500 m (–BD). *F. Brusse 3105*, 2.v.1981 (LD, PRE). **3219** (Wuppertal): 17 km W of Citrusdale, top of Middelberg Pass, on W facing TMS, alt. 1 100 m (–CA). *F. Brusse 3058*, 2.v.1981 (COLO, LD, PRE). Lit. Moberg (1986).

Physconia grisea (Lam.) Poelt

SOUTH AFRICA, TRANSVAAL.—**2628** (Johannesburg): Johannesburg, Linksfield Ridge, corticole on a wide range of tree species, also on rock in shade or with a fair amount of debris, alt. 1 780 m (–AA). *F. Brusse 1129*, 27.vi.1976 (PRE).

Polychidium dendriscum (Nyl.) Henss.

SOUTH AFRICA, CAPE PROVINCE.—**3318** (Cape Town): Cape, Kirstenbosch, on mossy rocks (–CD). *S. Garside 5087* (NU); Large sandstone ledge and ridges in dense fynbos, trail from Platteklip Gorge to Woodhead Resevoir, Table Mountain, elev. 950 m (–CD). *M.E. Hale 72,084*, 23.i.1986 (PRE, on isotype of *Xanthoparmelia surrogata* Hale).

Porina nitidula Müll. Arg.

SOUTH AFRICA, NATAL.—**2931** (Stanger): Stella Bush, Durban, Natal, on leaves (–CC). *A.M. Bottomley 263b*, 15.x.1919, det. R. Santesson 1954 (PRE).

Porpidia corralensis (Räs) Brusse

SOUTH AFRICA, CAPE PROVINCE.—**3423** (Knysna): Tsitsikamma National Park, on TMS rock outcrop on W bank of Storms River mouth, on top face of rock, alt. 5 m (–BB). *F. Brusse 4749*, 1.ii.1986 (BM, COLO, PRE, UC). Lit. Hertel (1984).

Pyxine reticulata (Vain.) Vain.

SOUTH AFRICA, TRANSVAAL.—**2329** (Pietersburg): District Vuvani, 18 km NNE of Soekmekaar, on *Ficus burkei* on an E slope, alt. 1 100 m (–BD). *F. Brusse 1650*, 23–29.i.1981 (LD, PRE).

Ramalina peruviana Ach.

SOUTH AFRICA, NATAL.—**2732** (Ubombo): Makhathini flats, a few km from Jozini on road to Sodwana Bay, on twigs, alt. c.100 m (–AC). *L. Henderson 4460*, 8.xi.1980 (PRE); 45 km from Mkuze to Sodwana Bay (–AD). *C.H. Stirton 8866*, 13.v.1981 (BM, LD, PRE). **2832** (Mtubatuba): Hlabisa, Palm Ridge Farm, coastal sandflats, scrub with scattered trees, occurs on small trees and shrubs (–AC). *E.R. Harrison 473*, 30.iv.1968 (BM, LD, PRE).

CAPE PROVINCE.—**3325** (Port Elizabeth): Alexandria district, 5 km from Paterson to Addo, farm Vista, on bark (–BD). *E. Retief 487*, 22.vii.1980 (PRE). **3326** (Grahamstown): Bathurst area, view and picnic site overlooking horseshoe bend of Kowie River, on twigs of tree on edge of cliff, mist affected, alt. c.200 m (–DB). *S.J. Smithies 106*, i.1981 (PRE).

Ramalina tenella Müll. Arg.

SOUTH AFRICA, NATAL.—**2832** (Mtubatuba): Hlabisa, Palm Ridge Farm, coastal sand flats, on small trees and shrubs (–AC). *E.R. Harrison 4298*, 30.iv.1968 (LD, PRE). **2930** (Pietermaritzburg): Pinetown, on *Citrus* branches (–DD). *E.M. Doidge 1549*, 24.xi.1933 (PRE).

CAPE PROVINCE.—**3325** (Port Elizabeth): Addo National Park, on trees (–BD). *L.C.C. Liebenberg 4110*, vii.1962 (PRE).

Strigula maculata (Cooke & Massee) R. Sant.

SOUTH AFRICA, NATAL.—**2930** (Pietermaritzburg): Buccleugh near Cramond, on *Chrysophyllum* leaves (–AD). *E.M. Doidge 270*, 17.viii.1917, det. R. Santesson (PRE). **3030** (Port Shepstone): Amanzimtoti, on leaves (–BB). *E.M. Doidge 268*, 10.vii.1911, det. R. Santesson (PRE).

Strigula subtilissima (Fée). Müll. Arg.

SOUTH AFRICA, CAPE PROVINCE.—**3423** (Knysna): Knysna, C.P., on *Cassine croceum* leaves (–AA). *A.M. Bottomley 1631b*, 23.iv.1939, det. R. Santesson 1954 (PRE).

Thelotrema berkeleyanum (Mont.) Brusse, *comb. nov.*

Basionym: *Stegobolus berkeleyanus* Mont. Hook., Lond J. Bot. **4**: 4. 1845.

Synonym: *Ocellularia berkeleyana* (Mont.) Zahlbr. Engler-Prantl, Naturl. Pflanzenfam., teil **1**(1): 118. 1905.

SOUTH AFRICA, CAPE PROVINCE.—**3323** (Willowmore): Distr. Knysna, Gouna Forest, on bark of *Faurea macnaughtonii* (–CC). *Ove Almborn 3296*, 19.viii.1953, det. M. Hale as *Ocellularia b.* (LD, PRE).

Thelotrema subtile Tuck.

SOUTH AFRICA, CAPE PROVINCE.—**3323** (Willowmore): Distr. Knysna, Deepwalls, on bark of indig. tree (–CC). *Ove Almborn 3534*, 21.viii.1953, det. M. Hale 1973 as *Ocellularia s.* (LD, PRE); Distr. Humansdorp, Stormsrivier, on *Ocotea* near 'the big tree' (–DD). *Ove Almborn 3799*, 24.viii.1953, det. M. Hale as *Ocellularia s.* (LD, PRE).

Tricharia albostrigosa R. Sant.

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Pilgrim's Rest, on leaves of *Cassine sp.*, alt. 1 750 m (–DD). *F. Venter 10583b*, 20.ii.1985 (PRE). Lit. Serusiaux (1984).

Usnea (Eumitria) baileyi (Stirt.) Zahlbr.

SOUTH AFRICA, NATAL.—**2831** (Nkandla): 5 km from Eshowe to Nkwaleni, farm 'Eyrie', on bark (–CC). *C.H. Stirton CH4536*, 12.x.1975 (PRE). **3030** (Port Shepstone): Umtamvuna Nature Reserve, South Ridge, on bark in short dry forest (–CC). *A. Abbott 1873*, 22.iii.1984 (PRE).

Usnea complanata (Müll. Arg.) Mot.

SOUTH AFRICA, TRANSVAAL.—**2231** (Pafuri): Kruger National Park, Punda Maria, on twigs (–CA). *A.M. Brynard 4054*, 11.viii.1959 (PRE). **2330** (Tzaneen): Magoebaskloof Hotel, tree in car park, on erect trunk (–CC). *C.H. Stirton 10605*, ii.1982 (PRE). **2530** (Lydenburg): Barberton, Cythna Letty nature reserve, on tree branches in forest (–DD). *H. Glen 1320*, 1984 (PRE).

Usnea (Eumitria) liechtensteinii Stnr.

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Distrik Pelgrimsrus: Hebronberg, noordelike berghang, teen oosliggende sandsteenkrans, ook bo-op, in volle sonlig, alt. 1 700 m (–DB). *P. Vorster 1876b*, 19.iv.1970 (PRE). **2527** (Rustenburg): Magaliesberg, Breedtsnek, on S facing quartzite cliffs, alt. 1 750 m (–CD). *F. Brusse 1116*, 19.iv.1976 (PRE).

Usnea perplexans Stirt

SOUTH AFRICA, TRANSVAAL.—**2329** (Pietersburg): Soutpansberg District, 2 km from Soekmekaar to Tzaneen, on *Acacia sieberana* var. *woodii*, on gentle slope, alt. 1 100 m (–DB). *F. Brusse 1724*, 23–29.i.1981 (PRE); 5½ km from Haenertsburg to Annies Fortune, on trees in small forest patch on a steep slope, terrain mountainous, alt. 1 600 m (–DD). *F. Brusse 1842*, 23–29.i.1981 (PRE). **2430** (Pilgrim's Rest): Mariepskop, bosboustasie, epifieties teen vertikale stam van aangeplante *Cussonia*, alt. 1 300 m (–DB). *P. Vorster 174b*, 16.i.1969 (PRE).

Usnea (Eumitria) welwitschiana Mot.

SOUTH AFRICA, TRANSVAAL.—**2430** (Pilgrim's Rest): Blyderiviervallei, op westelike rand, op sandsteen in volle sonlig, alt. c.1 500 m (–DB). *M. v.d. Merwe 55*, 18.iv.1970 (PRE).

NATAL.—**3030** (Port Shepstone): Oribi Gorge near Port Shepstone, on TMS (–CA). *F. Brusse 1490*, 27.xii.1978 (LD, PRE).

NOTES ON SOME PARMELIACEAE SPECIES

Parmelia astricta Brusse, *Bothalia* **15**: 315. 1984

Synonym: *Paraparmelia astricta* (Brusse) Elix & Jen Johnston, *Mycotaxon* **27**: 279. 1986.

The paratype specimen (*F. Brusse 3444*) from the top of Swartberg Pass between the Cango Caves and Prince Albert, was originally stated to contain gyrophoric acid. This has proven to be erroneous and it contains olivetoric acid in addition to alectoronic acid. Olivetoric acid is therefore best not regarded as an accessory, as originally stated, but as a major constituent of this species.

Additional material of this species was collected in early 1986 and distributed as follows:

SOUTH AFRICA, CAPE PROVINCE.—**3321** (Ladismith): 15 km N of Riversdale, Garcia's Pass, SW side of Kareekop, on low lying TMS outcrops on S slope, partially shaded by shrubs, alt. 550 m (–CC). *F. Brusse 4911*, 8.ii.1986 (BM, LD, US). **3322** (Oudtshoorn): 19 km S of Prince Albert, summit of Swartberg Pass, collected on W side of road, on steep SE rocky slope, on TMS near crevices, on low lying rock, alt. 1 650 m (–AC). *F. Brusse 4878*, 6.ii.1986 (BM, LD, PRE, US); Robinson's Pass between Mossel Bay and Oudtshoorn, SW slopes of Ruitersberg, on N sides of TMS boulders, in partial shade of shrubs, near ground level, alt. 790 m (–CC). *F. Brusse 4808*, 4.ii.1986 (BM, LD).

Paraparmelia olivetorica Nash & Elix (1987), reported to contain olivetoric and 4-0-demethylmicrophyllinic acids, is obviously a closely related species, if not part of a chemosyndromic series of *Parmelia astricta*.

Parmelia cedrus-montana (Brusse) Brusse, *Bothalia* **15**: 320. 1984.

Synonym: *Xanthoparmelia cedrus-montana* Brusse *Jl. S. Afr. Bot.* **49**: 145. 1983.

A further collection of the type strain of this species has been made at Gwarrie Poort near Willowmore.

SOUTH AFRICA, CAPE PROVINCE.—**3323** (Willowmore): 16 km from Willowmore to Uniondale, Gwarriepoort, Suurberg se Loop valley, SE slopes of Rebosrand, on quartzite cliff, alt. 910 m (–AD). *F. Brusse 4859*, 6.ii.1986 (BM, COLO, LD, PRE, UC, UPS, US).

Parmelia eximia Brusse, *Mycotaxon* 27: 183. 1986.

Synonyms: *Xanthoparmelia calvinia* Hale, *Mycotaxon* 27: 567. 1986.

Xanthoparmelia competita Hale, *Mycotaxon* 27: 568. 1986.

These names appeared simultaneously, so the epithet '*eximia*' has priority in *Parmelia*, and one of two synonyms listed above in *Xanthoparmelia*. Although Hale (1986) regarded *X. calvinia* as distinct due to the presence of 'isidia', these are no more than high bullae, which can easily be decapitated mechanically. Very many species from arid areas are bullate in the centre of the thallus. These collections increase the range of this species considerably, and the distribution is not as restricted as previously thought (Brusse 1986). The acetone extracts of the holotype of this species and the isotypes of *X. calvinia* and *X. competita* were run together on the same TLC plate, and compared with some lichens containing 4-O-methylhypoprotocetraric acid, particularly *P. hypoprotocetrarica* Kurok., which often contains this substance in minor quantities. This confirmed the suspicion that unknown FB-6 (Brusse 1986) is probably 4-O-methylhypoprotocetraric acid, as indicated by Brusse (1980). Jen Johnston of the Australian National University in Canberra has also indicated that this is 4-O-methylhypoprotocetraric acid (determination slips in the paratype of *P. eximia*). A trace of hypoprotocetraric acid was also stated to be present. FB-1 and FB-2 are the two other major substances present and these appear to be new unknown substances, not treated by Culberson & Hale (1973). The types of *P. eximia* and *X. calvinia* are identical in chemistry containing 4-O-methylhypoprotocetraric acid, FB-1 and FB-2 and a low substance related to FB-1. However *P. eximia* also contains low aliphatic acids, clearly visible on plate B, but obscured on plates A and C. The isotype of *X. competita* lacks unknown FB-1 and the lower running related substance, and the aliphatic acids. However all three types are clearly united by the presence of 4-O-methylhypoprotocetraric acid (FB-6) and unknown FB-2, and the variation is of a chemosyndromic nature with the aliphatic acids as accessories.

An isotype specimen has been lodged at ANUC, in addition to the herbaria originally indicated. A paratype specimen has been lodged at US, in addition to the herbaria originally cited.

Parmelia fausta Brusse, *Mycotaxon* 27: 185. 1986.

An isotype specimen has been lodged at ANUC, in addition to the herbaria originally indicated.

Xanthoparmelia hybrida Hale, *Mycotaxon* 27: 580. 1986.

An examination of the isotype specimen revealed the presence of usnic and protocetraric acids and unknown Th-1. The original publication stated the presence of stictic and constictic acids in addition to protocetraric and usnic acids, but this could not be confirmed. The unknown Th-1 seems to be a very pale yellow pigment, which reacts with a 2 molar solution of potassium hydroxide, rapidly giving a bright orange-red colour. Stictic and constictic acids slowly become yellow with the same reagent. Deeper colours are due to the co-occurrence of norstictic acid, but again, these develop slowly, and are duller reds or red-oranges.

This substance (Th-1) is common in *Parmelia cedrus-montana*, and has been found in *P. endomiltodes* Nyl. (the type of *Xanthoparmelia ianthina* Brusse contains this substance and Th-2, with the 'endomiltodes anthraquinone pigments') and also in *P. hypoleia* Nyl. with protocetraric acid. For this reason it is regarded as an accessory substance, and *X. hybrida* is regarded as a synonym of *P. mutabilis* Tayl. (see below).

Parmelia insignis Brusse, *Mycotaxon* **27**: 186. 1986.

A further isotype specimen has been deposited at ANUC.

Dr. J.A. Elix has suggested that this species contains stenosporonic acid as the major substance and colensoic acid as the minor substance (Elix *in litt*), and also that it is a synonym of *Parmelia mongaensis* Elix. While I have not been able to examine the type of *P. mongaensis*, I have been able to compare it to *Xanthoparmelia shebaiensis* Nash & Elix (1987) and *P. stenosporonica* (Hale) Brusse. On TLC plates the substances move identically, although insig-1 is more pale yellow-brown than stenosporonic acid, which is a more pale olive-green colour, on the same plate. Although *P. mongaensis* was originally described as containing grayanic and colensoic acids (Elix 1981), this has recently been corrected to stenosporonic and colensoic acids (Culberson *et al*. 1985). The difference in spot colour on the same plate gives me some reservation as to what insig-1 is, in the absence of a confirmatory test.

In the original description of *P. mongaensis* Elix (1981) the ascospores were reported as 11–13 X 7–10 µm, which is quite large for a *Paraparmelia*, which are supposed to fall within the range 7–10 X 4–6 µm (Elix *et al*. 1986). While the type material of *P. insignis* is sparsely apotheciate, the hymenia have been partly damaged by mite grazing, and the remainders contain only few ascospores, a concerted effort to find ascospores, revealed that they are within the range normal for a *Paraparmelia*. This requires confirmation with better fertile material.

For the present, therefore, the decision to synonomize *P. insignis* with *P. mongaensis* is delayed until more data becomes available.

Parmelia insipida Brusse, *Mycotaxon* **27**: 238. 1986.

An isotype specimen has been deposited in ANUC, in addition to those originally cited.

Originally this species was known from the Sneeuwberg at Lootsberg Pass (type locality) and the south-western end of the Drakensberg at Barkly Pass (originally misspelt 'Barkleys Pass') near Elliot. Recently the range has been extended further north-east to Qacha's Nek near Matatiele, by the following specimen:

SOUTH AFRICA, TRANSKEI.—**3028** (Matatiele): 32 km NNE of Matatiele, Qacha's Nek, near Transkei/Lesotho border on Transkei side, on Clarens (cave) sandstone on E slope in mountainous terrain, alt. 1 950 m (–BA). *F. Brusse 4579*, 25.i.1986 (BM, COLO, LD, PRE).

Parmelia lesothoensis (Hale) Brusse

Synonym: *Xanthoparmelia lesothoensis* Hale, *Mycotaxon* **27**: 582. 1986.

An examination of the isotype specimen of this species, revealed all the originally reported substances (usnic, salacinic and diffracteic acids), as well as the 'chalybaeizans unknown'.

Xanthoparmelia lividica Hale, *Mycotaxon* **27**: 584. 1986.

The reported cortical chemistry of this species (usnic acid), could not be confirmed in a thin-layer chromatographic study of the isotype specimen. Instead atranorin was the only cortical substance found, and no trace of usnic acid could be detected. The medulla contains colensoic and lividic acids as reported. More collections are needed to eliminate the possibility that this species does not intergrade chemosyndromically with *Parmelia mongaensis* Elix.

529	fig.	14	for	Sphaeophrag		
551	line	25	for	*P. hypo-*	read	*Parmelia hypo-*

Parmelia marroninipuncta Brusse, *Bothalia* **15**: 315. 1984.

An additional isotype specimen has been deposited at COLO.

Recently a large collection of this lichen was made:

SOUTH AFRICA, CAPE PROVINCE.—**3225** (Somerset East): Mountain Zebra National Park near Cradock, Bankberg mountains, Wilgeboom River Valley, just beyond poplar grove from dam, dolerite ridge on W side of road, on siltstone and dolerite on steep E slope, alt. 1 280 m (–AB). *F. Brusse 4685*, 29.i.1986 (BM, COLO, LD, MEL, PRE, S, UC, UPS, US).

Parmelia mutabilis Tayl., *Lond. J. Bot.* **6**: 171. 1847.

There is type material of this species both in BM and FH, but FH is the only herbarium with material labelled with the words '5' and 'Uitenhage' as cited in the original description. This material, which must be regarded as the holotype, consists of two specimens, both of which contain usnic, fumarprotocetraric and succinoprotocetraric acids, and which are morphologically essentially the same. This lichen has previously been variously referred to as *P. subconspersa* Nyl. and *P. phaeophana* Stirt., although the list of synonyms is now very long.

The latin description fits the holotype material fairly well, except for the word 'cinereus' (= grey), which was used to describe the colour of the thallus. In the postamble the author compared the lichen to *P. conspersa* Ach. in its mode of branching, and to *P. herbacea* (Huds.) Ach. (= *Lobaria laetevirens* (Lightf.) Zahlbr.) in colour and general habit. This latter lichen is a tan colour when dry, and resembles a *Xanthoparmelia* rather than a *Paraparmelia*.

Since the lower surface was stated to be brown in the original description ('subtus fuscentibus'), the material with a brown lower surface must be selected. This excludes most of the rest of the syntype material, labelled as from Uitenhage, which is *P. hypoleia* Nyl., a maculate lichen with a black lower surface.

Xanthoparmelia olivetorica Hale, *Mycotaxon* **27**: 591. 1986.

The description of this species is based on a mixture of two species. One species is grey and contains atranorin and olivetoric acid, and the other is yellow and contains usnic and gyrophoric acids. The grey species is probably *Parmelia astricta* Brusse with the alectoronic acid obscured on the TLC plates, and other species is probably *Parmelia endochromatica* (Hale) Brusse, the type of which comes from very close-by or even from the same spot on Table Mountain. Neither of the 'schenkiana pigments' were found in *X. olivetorica*, but pigments are produced in older parts of the lobes, and are sometimes not detectable, as in *P. schenckiana* itself.

Parmelia patula Brusse, *Bothalia* **15**: 317. 1984.

An additional isotype specimen has been deposited at US.

Although the type of this species is quite tightly adnate, I include in the range of variation such looser forms as *Xanthoparmelia oribensis* Hale.

Parmelia ralla Brusse, *Mycotaxon* **27**: 240. 1986.

An additional isotype specimen has been deposited at ANUC.

The range of this species is now known to cover the whole of the Cape fold mountain area up to Uniondale, by the following additional specimens:

SOUTH AFRICA, CAPE PROVINCE.—**3219** (Wuppertal): Clanwilliam district, Biedouw Valley, 1 km S of Mertenhof, on low TMS kranzes on gentle N facing slope, alt. 500 m (–AA). *F. Brusse 3168*, 3.v.1981 (BM, LD, PRE). **3318** (Cape Town):

Bothmaskloof Pass near Riebeeks Kasteel, Porseleinberg, on TMS outcrops on NW slope, alt. 350 m (–BD). *F. Brusse 2777*, 28.iv.1981 (PRE).

Parmelia scitula Brusse, *Bothalia* **15**: 317. 1984.

An isotype specimen has been deposited at COLO, in addition to the LD & PRE of the original publication.

Parmelia spargens Brusse, *Bothalia* **15**: 318. 1984.

The range of this species has been extended by the following specimens:

SOUTH WEST AFRICA/NAMIBIA.—**2016** (Otjiwarongo): 7 km S of Otjiwarongo, tall boulder strewn koppie, on granite on S slope (–DA). *F. Brusse 4207*, 21.iii.1984 (PRE).

SOUTH AFRICA, CAPE PROVINCE.—**3322** (Oudtshoorn): 10 km S of Prince Albert, Dorps River valley, at picnic site, on vertical S TMS cliff, at N base of large mountain range (Swartberg range), alt. 790 m (–AC). *F. Brusse 4885*, 7.ii.1986 (BM, COLO, LD, PRE); 9 km N of De Rust, Meiringspoort, on SW TMS outcrop with 30° slope, alt. 550 m (–BC). *F. Brusse 4826*, 5.ii.1986 (BM, COLO, LD, PRE, UPS, US).

Parmelia thamnolica (Hale) Brusse

Synonym: *Xanthoparmelia thamnolica* Hale, *Mycotaxon* 27: 604. 1986.

An examination of the isotype specimen, showed that no thamnolic acid was present as originally reported. This was immediately clear, because the medulla did not react with K. However, the chemistry is new for a *Xanthoparmelia* containing squamatic acid and two unidentified substances in the medulla. Garbarino *et al.* (1987) have identified 2-O-methylsquamatic acid in *Protousnea magellanica* (Mont.) Krog, which may be the same as one of these unidentified substances.

Parmelia unctula Brusse, *Bothalia* **15**: 319. 1984.

An isotype specimen has been deposited at LD.

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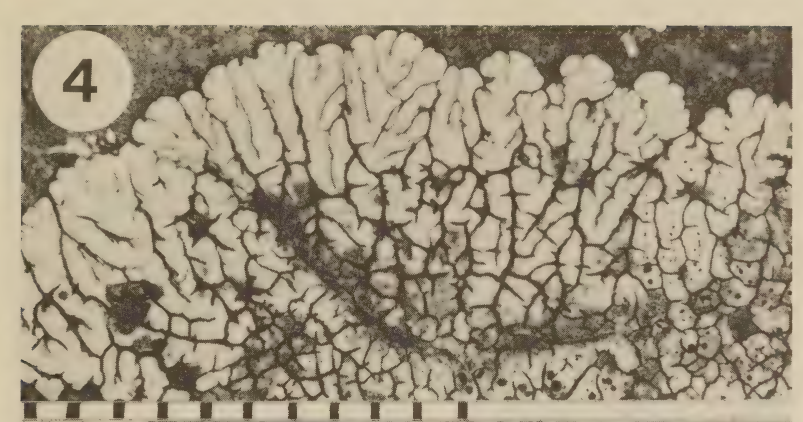
FIGURE 4.—*Parmelia adligans* Brusse, habit. *F. Brusse 4452*, holotype. Scale in mm.

FIGURE 5.—*Parmelia arquata* Brusse, habit *F. Brusse 1126*, holotype. Scale in mm.

FIGURE 6.—*Parmelia ganymedea* Brusse, habit. *F. Brusse 5089*, holotype. Scale in mm.



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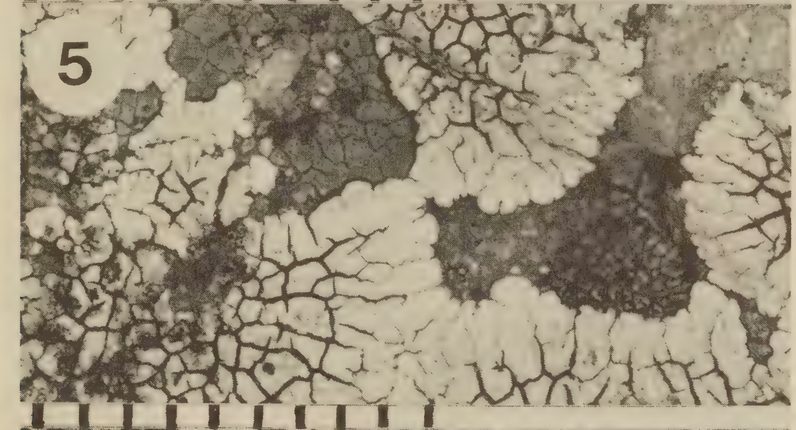

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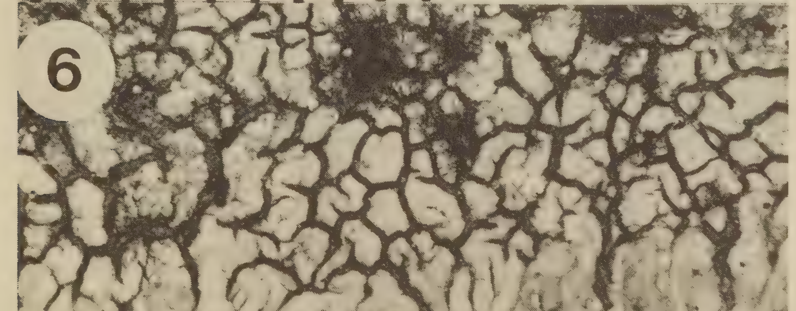

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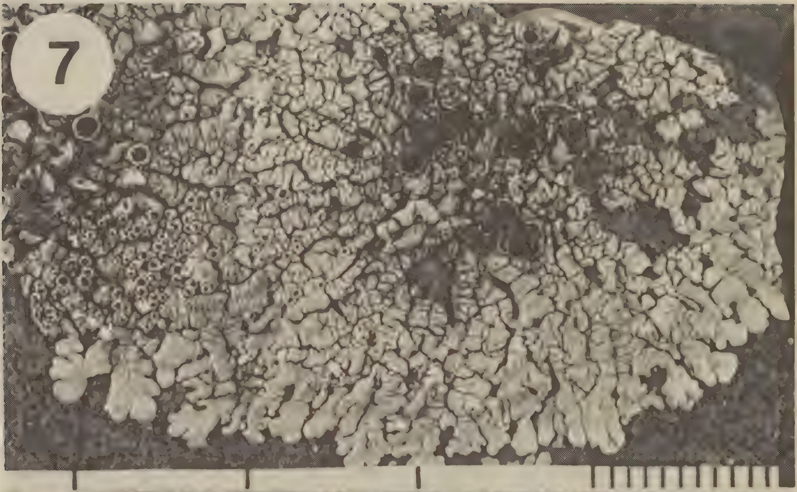

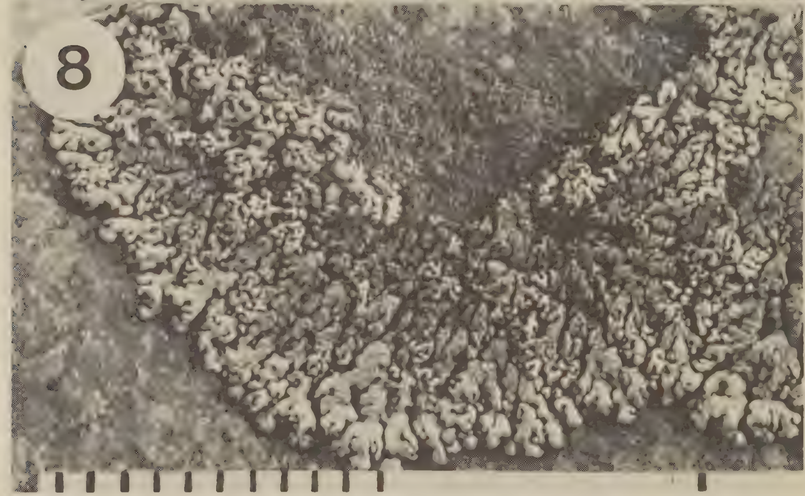

FIGURE 7.—*Parmelia sigillata* Brusse, habit. *F. Brusse 4827*, holotype. Scale in mm and cm.

FIGURE 8.—*Parmelia verecunda* Brusse, habit. *F. Brusse 4790*, holotype. Scale in mm and cm.

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MYCOTAXON

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RUTSTROEMIA ALLANTOSPORA : AN UNDESCRIBED SPECIES OF THE SCLEROTINIACEAE FROM SPAIN.[1]

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SUMMARY

Rutstroemia allantospora Galán, Honrubia & Palmer is described as a new species for science. Its peculiar habitat (little decomposed bark of *Pinus* spp. branches) together with the hymenial characters and the microanatomy of the apothecia are used to separate it from *Rutstroemia firma* (Pers.: Fr.) Karst. Photomicrographs show the more important characters, using an optical microscope.

RESUMEN

Se describe *Rutstroemia allantospora* Galán, Honrubia & Palmer como especie nueva para la Ciencia. Su peculiar hábitat (corteza de ramas poco descompuestas de *Pinus* sps.), unido a las características de los constituyentes del himenio y a la microanatomía de los apotecios, son usadas como elementos de separación con *Rutstroemia firma* (Pers.: Fr.) Karst. Se aportan microfotografías al microscopico óptico de los caracteres más sobresalientes de la especie.

METHODS

Microscopic studies have been made using 5% KOH, 2% KOH-Phloxine, Melzer's Reagent and Lactophenol-Methyl Blue. Photomicrographs, including phase contrast, were made with a Nikon microscope, Optiphot model, with an incorporated automatic system. Line drawings were prepared using a camera lucida. Mass ascospore cultures were grown in test tubes at room temperature on P.D.A.

Specimens of the type collection are preserved in the private herbaria of the three authors: RG (R. Gálan), MHG (M. Honrubia) and JTP (J. T. Palmer) with duplicates in various Spanish universities and research centres as part of the *Mycotheca Hispanica* and Cornell University (CUP) whilst the other three collections are in herbaria RG and MHG.

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[1] *This paper was presented in a slightly different form at the Simposio de Botánica Criptogámica VIII on 23-26 September, 1987, in Madrid.*

INTRODUCTION

Following the appearance of a recent publication (HONRUBIA, BERTAULT & LLIMONA, 1983), one of us (R. G.) became interested in the study of certain collections identified by these authors as *Rutstroemia firma* (Pers.) Karst.

The more important characters of these collections, judging from the description and illustrations, are the bicellular, incurved ascospores and, above all, the very characteristic habitat: corticated branches of *Pinus halepensis* Miller.

WHITE (1941) studied not only the type of *Peziza firma* but also additional specimens from various Central European countries and, in accordance with his excellent description, this species, also known as *Poculum firmum* (Pers. : Fr.) Dumont, is characterized by its weakly inequilateral ascospores, at first unicellular, with 3-5 septa at maturity and erumpent from the stromatized wood beneath or through fissures in the bark of deciduous trees, especially *Quercus*. He included a translation of *Rutstroemia firma* var. *acuum* Feltgen, apparently only known from the original collection on *Pinus* needles in Luxembourg and commented: "No morphological characters are indicated which would separate this variety from the species and it is here maintained only because of its rather distinctive habitat."

Therefore, motivated by these contradictions and in collaboration, the collections in Herb. Murcia and those to which we have previously referred, have been restudied. In addition, fresh material on *Pinus halepensis* as well as *Pinus* sp. (*P. pinaster* Aiton and *P. nigra* Arnold subsp. *salzmannii* (Dunal) Franco growing together in a mixed wood) have also been investigated.

The results indicate a distinct taxon and a species new to science is therefore proposed.

DESCRIPTION

Rutstroemia allantospora Galán, Honrubia & Palmer sp. nov.

MISAPPLICATION: *Rutstroemia firma* (Pers.) Karst. by Honrubia, Bertault & LLimona in Bull. Soc. Mycol. France **99**: 299 (1983).

Stroma praesens, parte externa dubium, sed patens obscura zona super externam corticis faciem. **Apothecia** gregaria, cupulata, stipitata et rufofusca. **Receptaculum** pruinosum. **Discus** 0.3-0.8 mm. diam. **Stipes** semper manifestus, variable incrementum habet. **Excipulum Ectale** tribus tegumentis formatum. Externum tegumentum raris hyphae, fuscis, ramosis, flexilibus, laxisque formatum, dispositis paribus intervallis superficiei, tenuibus parietibus, cumque pictus fulcimentis est incrustans. Tegumentum medium hyphae hyalinis formatum, quoque paribus intervallis superficiei dispositus, angustis luminibus et valde glutinosis parietibus. Tegumentum interius indefinita magnitude, formatum hyphae simillimis componentium internus stratum. **Medullare Excipulum** intricata textura. **Subhymenium** densum, (textura intricata aunt textura epidermoidea). **Asci** octosporici, subcylindrati, J+, (70)-85-115 x 6.8-8 µm. **Ascosporae** allantoides, sigmoideo aspectum, (0-)1(-2) septatis, hyalini 10.5-15.5 x 2.4-3.5 µm, quae microconidia in uno vel duobus extremis generant. **Microconidia** subglobosa (x 2-2.5 µm) uniguttulata. **Paraphyses** subclavatae (x 2.4-4.3 µm), pluriseptatae; summum culmen colore fusco.

Habitat: in cortice ramorum mortuorum *Pini halepensis*; in Aceniche, Bullas, in provincia Murcia, in Hispania; Legit M. Honrubia et J. T. Palmer (8-xii-1984); Holotypus: RG 348 et isotypi in CUP 61858, JTP 4130 and MHG 426-2.

Stroma externally indeterminate but appearing as a darkened area on the underside of the bark with no stromatization of the phloem. **Apothecia** gregarious, cupulate, stipitate, reddish brown. **Receptacle** pruinose. **Disc** 0.3-0.8 mm in diameter. **Stipe** always present, although from well developed to variable (equal in length to the diameter of the disc), often very slightly villose at the base. **Ectal Excipulum** in three layers: outer zone formed of some sparse rows of loosely branched, flexuous, brown hyphae (x 3-6.5 µm in diam.) arranged parallel to the surface, with thin walls encrusted with pigment giving a typically banded aspect *(Figs. 3 & 5c)*. The medial layer (30-38 µm thick) is formed of hyaline hyphae, similarly parallel to the surface, with very small lumina and strongly gelatinized walls *(Figs. 1 & 3)*. The inner zone, of imprecise thickness and not well delimited from the Medullary Excipulum, is formed of very similar hyphae to the outer zone, (i.e. encrusted walls, loose and parallel with coloured contents) but lighter in colour and up to 10 µm in diameter *(Fig. 1)*. **Medullary Excipulum** well developed, of *textura intricata* and subhyaline cells with thin, smooth walls (3-6.5 µm in diam.) *(Figs. 1 & 2)*. **Subhymenium** compact, sparsely developed, formed of densely woven brown hyphae: *textura intricata* or *textura epidermoidea* *(Fig. 1)*. **Asci** 8-spored, subcylindrical (tapering below to form a pedicel of imperceptible limits) with a broad, ± rounded apex and a broad plug, J+, (70-)85-115 x 6.8-8 µm *(Figs. 1, 4 & 5)*. **Ascospores** allantoid, inequilateral, sometimes slightly sigmoid with (0-)1(-2) septa, hyaline and producing microconidia at one or both apices (present even in the asci), (10.5)-11.5-15.5 x 2.4-3.1(-3.5) µm *(Figs. 1, 4 & 5)*. **Microconidia** subglobose (x 2-2.5 µm), uniguttulate *(Figs. 1, 4 & 5)*. **Paraphyses** subclavate, branched at the base (x 2.4-4.3 µm), pluriseptate, brown at the apex and appearing hyaline below with length similar to and not protruding above the asci *(Fig. 5)*.

ETYMOLOGY: From Latin: **allantoideus** (sausage-shaped) and **sporae** (spores), referring to the shape of the ascospores.

ADDITIONAL SPECIMENS EXAMINED: On bark-covered twigs and branchlets of fallen branches of *Pinus halepensis* Miller (1) or *Pinus* sp. (2): El Carrascalejo, Bullas, prov. Murcia, (1), 27-x-1979, X. LLimona, MHG 2343; Valle de Leiva, Sierra de Espuña, prov. Murcia, 3-xii-77 (1), X. LLimona, MHG 426, *Mycotheca Hispanica 187*; Los Reales, Estepona, prov. Málaga, Spain, 13-vi-1984, (2), M. Honrubia, R. Galán & J. Larios, RG 328.

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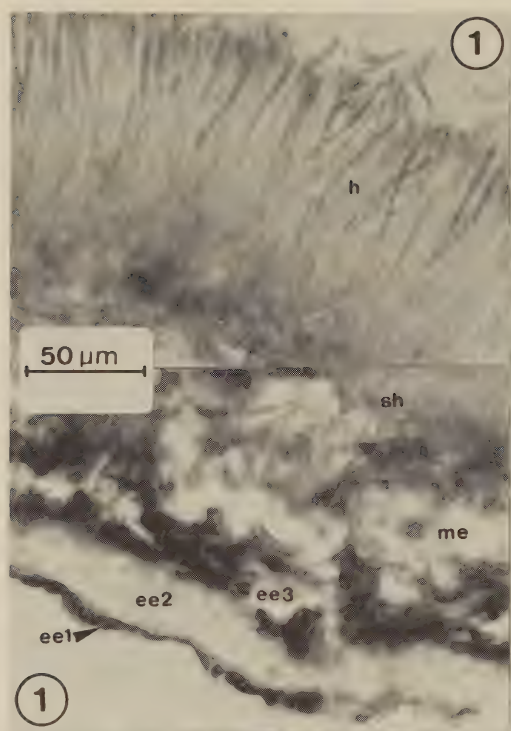
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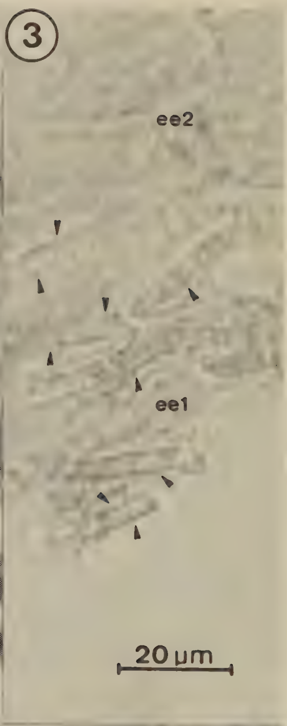
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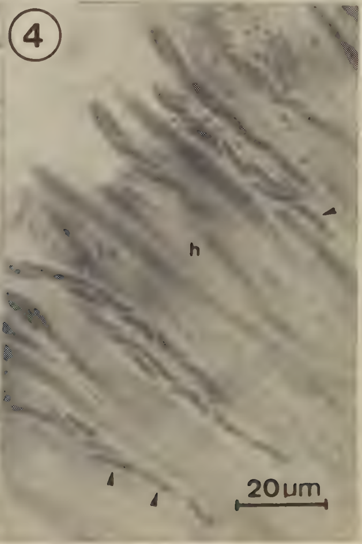


Rutstroemia allantospora

FIG. 1: Longitudinal section of apothecium to show the Hymenium (**h**), Subhymenium (**sh**), Medullary Excipulum (**me**) and the external (**ee^1**), medial (**ee^2**) and internal (**ee^3**) of the Ectal Excipulum.

FIG. 2: Intermixed hyphae in the Medullary Excipulum.

FIG. 3: Gelatinized medial layer (**ee^2**) and external layer (**ee^1**) of the Ectal Excipulum showing the encrustation of the hyphae (**arrows**).

FIG. 4: Hymenium (**h**) with 8-spored Asci and 1-septate Ascospores.

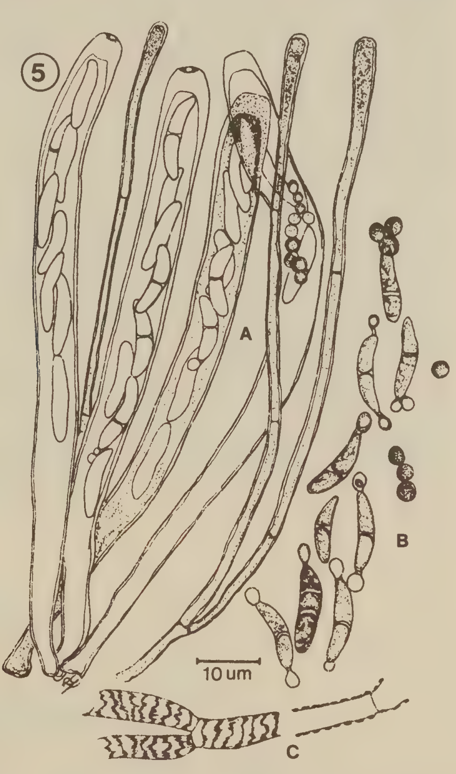
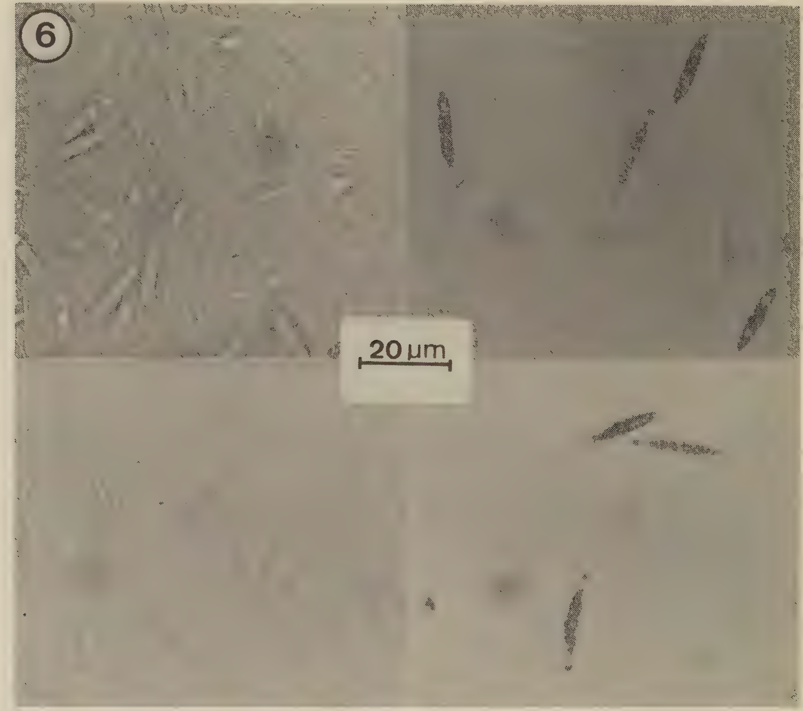


FIG. 5: 8-spored Asci and Paraphyses *(a)*, Mature Ascospores and Microconidia *(b)* and Hyphae from the exterior of the Ectal Excipulum showing the banded reinforcement of the walls *(c)*.

DISCUSSION

This species is distinguished by its mainly 1-septate, narrowly allantoid ascospores and the banded roughening on the tomentum emerging from the gelatinized excipular zone, as similarly stated to occur in *Elliottinia kerneri* (Wettst.) Kohn (L. M. KOHN in litt.) and development from the bark of *Pinus* spp. The species belongs in the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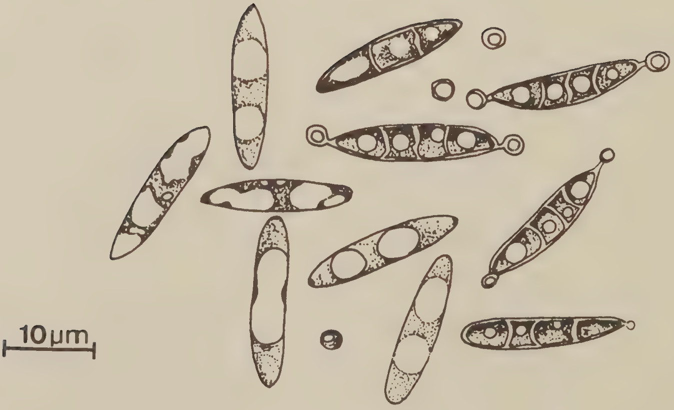
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genus *Poculum* Velen., as typified by DUMONT (1972), which is characterized by a stratum of ± prismatic, gelatinized cells in the ectal excipulum constructed in a complicated manner and formed of prosenchymatous cells. However, in view of the recent vote of the Committee for Fungi and Lichens of the International Association for Plant Taxonomy to conserve the generic name *Rutstroemia* Karst. with *R. firma* (Pers.: Fr.) Karst. as its type, we are now required to adopt *Rutstroemia*. Therefore *Poculum* Vel. is a taxonomic synonym.

It undoubtedly has affinities with *Rutstroemia firma*, not only macroscopically but also in the microanatomy of the apothecium. Despite this, *R. firma* has no "banded" hyphae in the excipulum and the asci are longer, 130-153 x 9-10.5 µm with the ascospores nearly straight or slightly inequilateral, larger, 15.5-21 x 4-5.5 µm in Spanish specimens. WHITE (1941) gave the asci as 125-150 x 9.5-13 µm and ascospores as 14-19 x 4.7-6.5 µm, becoming 3-5 septate at maturity ***(Fig.6)***. PALMER & TRUSZKOWSKA (1969) reported on two collections on *Quercus robur* twigs in Poland with asci 118-157 x 6.1-10.8 µm and ascospores 12-17.7 x 3.7-6.4 µm, narrowly ellipsoid with pointed ends, 2-multiguttullate and becoming septate. DENNIS (1978) gives the asci as 150 x 12 µm and ascospores as 14-19 x 4.0-6.5 µm, becoming 3-5 septate at maturity. The characteristic short-stipitate apothecia may very well have been due to the typically aerial habitat as stipes of apothecia subsequently developed in natural culture were up to 7 mm long and may similarly occur on twigs immersed in the soil or leaf litter.

This new taxon has been reported by HONRUBIA & al.(1983) with asci 120-140 µm and ascospores 15-19 x 3-4 µm; these dimensions have not been encountered in the present revision.

ACKNOWLEDGEMENTS

The authors wish to express their profound gratitude to Professor R. P. Korf, as well as Drs. L. Holm and L. M. Kohn, for their valued comments on this taxon and Mr. H. G. Ward (Bath, England) for advice on the Latin diagnosis.

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Rutstroemia firma:

FIG. 6. Typical Ascospores with 0-2-3 septa and Microconidia.

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THE LICHEN GENUS LAURERA (FAMILY TRYPETHELIACEAE) IN INDIA

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ABSTRACT

Seventeen species of Laurera Reichenb. are described in detail together with a key to species. Laurera cumingii, L. megasperma, L. phaeomelodes, L. sphaerioides and L. varia are new to India and L. alboverruca, L. aurantiaca, L. columellata, L. fusispora, L. indica, L. sikkimensis, L. subsphaerioides, L. tuberculosa, L. verrucoaggregata and L. vezdae are new species.

INTRODUCTION

The genus Laurera Riechenb. characterized by the ascomata embedded in pseudostroma, fissitunicate asci, interthecial hyphae branched and anastomosed, forming a loose and regular reticulum and hyaline, muriform ascospores, is placed in the family Trypetheliaceae, based on the inclusion of the ascomata in pseudostroma, together with the four other genera - Bottaria, Melanotheca, Tomasellia and Trypethelium (Zahlbruckener, 1926; Letrouit - Galinou, 1957, 1958 and Harris, 1975.)

Recently, however, Harris placed the genera Bottaria (= Mycoporum Flot. ex. Nyl.) and Melanotheca in the family Pyrenulaceae and Tomasellia in the family Mycoporaceae (Bryologist and Evansia, in press).

Vezda (1968), who found the asci of both Laurera and Trypethelium to be bitunicate, removed Laurera to a separate group along with some species of Polyblastiopsis, while Poelt (1974), preferred to place the genus in the provisional family Laureraceae but referred Phyllobathelium also to the same family. Eriksson (1981), however, is of the openion that if the family Trypetheliaceae is split up and Laurera is segregated into a family of its own, the name of this family should not be Laureraceae (sensu Poelt, 1974) but Crypototheliaceae.

In the revisionary study of Laurera, Letrouit-Galinou (1957, 1958) distinguished six different groups, in the genus based on the resemblences of the species particularly in the type of the structure of the pseudostroma, namely : *L. octospora* (Fig. 1), *L. megasperma* (Fig. 2), *L. sphaerioides* (Fig. 3), *L. phaeomelodes* (Fig. 4), *L. cumingii* (Fig. 5) and *L. madreporiformis* (Fig. 6).

Thus, the structure of the pseudostroma, morphology of the thallus and the ascospores provide good taxonomic criteria for the speciation in *Laurera*.

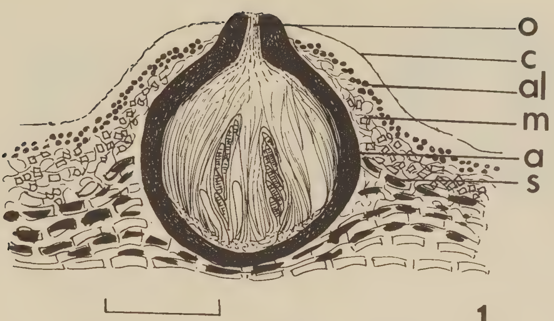
Laurera includes 31 corticolous species and 4 varieties distributed mainly in tropical regions of the world (Letrouit - Galinou, 1957, 1958). Recently, Harris (1984) described one species of the genus, *L. aurata* Harris from Brazil and recognized *L. subdisjuncta* (Müll. Arg.) Harris (synonym *L. dodgei* Letr. G.) from Cuba and Galloway (1985), recorded *L. elatior* (Stirton) Galloway, from New Zealand.

In India the first records of the genus were made by Nylander (1869), who reported two species : *L. benguelensis* (Mull. Arg.) A. Zahlbr. (as *Trypethelium madreporiformis* Eschw.) and *L. subdiscreta* (Nyl.) A. Zahlbr. (as *Trypethelium subdiscretum* Nyl.) from Bengal, based on the S. Kurz collections.

Although a number of studies on the lichen flora of India have been carried out in recent years and several species of pyrenolichens have been reported, only two species, *Laurera* sp. from Chunabhatti of the Darjeeling district (LWU-66.104) by Awasthi and Agarwal (1970) and *L. madreporiformis* (Eschw.) Riddle, from 24-Parganas (n.675) by Roychowdhury (1985), have been recorded.

Seventeen corticolous species of this genus have so far been determined from lichen specimens collected in the Western Ghats, North East India and the Andaman Islands.

Figs. 1-6 : Structure of Pseudostromata 1. type *L. octospora* (Letrouit - Galinou, 1957, pl. I, fig. A), 2. type *L. megasperma* (73.2325), 3. type *L. sphaerioides* (85.869). 4. type *L. phaeomelodes*, eg. *L. verrucoaggregata* (86.550, Holotype - AMH); 5. type *L. cumingii* (85.1019), 6. type *L. madreporiformis*, *L. tuberculosa* (74.2689, Holotype - AMH). Explanation for the abbreviations used in figures. a, ascoma; al, algal layer; b, supplementary brown layer; c, an amorphous cortical zone; cx, zone of Ca-oxalate crystals; e, external zone (K + red); eb, external zone of brown hyphae; ib, inner zone of light brown hyphae; ic, inner amorphous zone; m, medullary zone (crystals studded); O, ostiole; ps.a; tissue of pseudostroma and ascomata; s, substratum cells; rs, red substance (K + purple). Scale = 500 µm.



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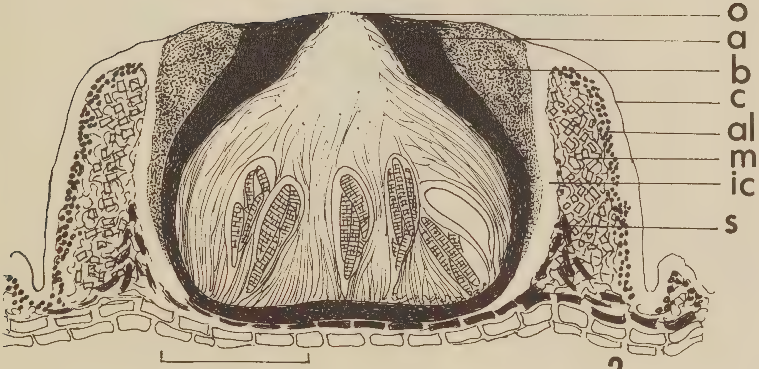
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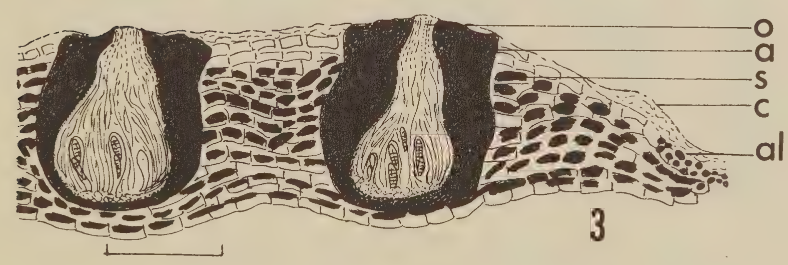

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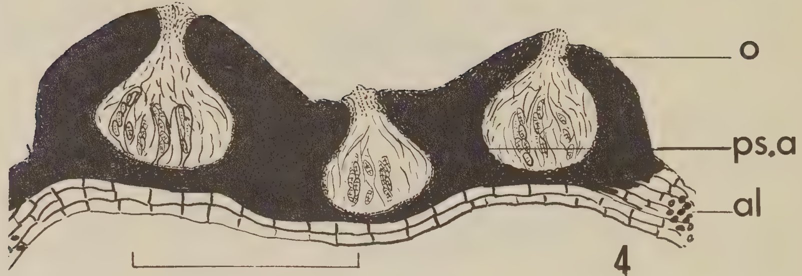

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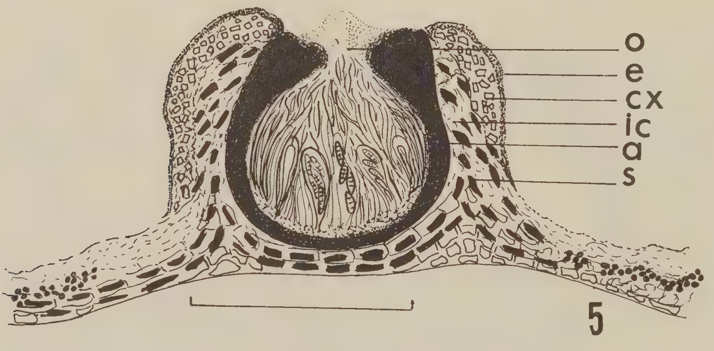

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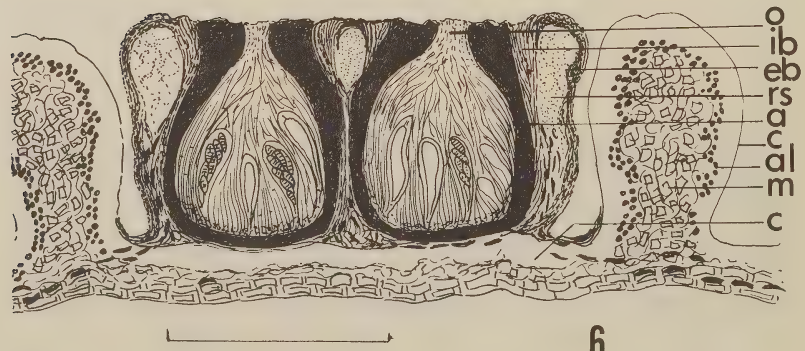
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KEY TO THE SPECIES

1a. Cortical zone present up to the ostioles of ascomata 2

1b. Cortical zone broken at the level of the thallus at the base of pseudostroma 11

(1a)2a. Cortical zone bending towards the bottom, skirting the wall of ascoma; algal layer present up to the ostiole; type *L. megasperma* 3

(1a)2b. Cortical zone not bending towards the bottom, algal layer broken at the level of thallus; type *L. sphaerioides* 9

(2a)3a. Ascospores 4/ascus, large, 200-300 µm in length (ascomata in concolorous pseudostromata); .... *L. megasperma*

(2a)3b. Ascospores 8/ascus, always less than 225 um in length 4

(3b)4a. Ascomata with columella or vertical walls (Multiloculate) 5

(3b)4b. Ascomata without columella or vertical walls (uniloculate) 6

(4a)5a. Ascomata with strong columella; pseudostromata concolorous with the thallus, with white, flattened top; ascospores 160-200 x 23-33 µm in size .... *L. columellata*

(4a)5b. Ascomata with strong, vertical walls, multiloculate; pseudostromata conical, dialated at the base; ascospores 66-150 x 23-36 µm in size .... *L. sikkimensis*

(4a)6a. Ascoma having hymenium saturated with orange globules; ascospores 115-135 x 26-32 µm in size .... *L. aurantiaca*

(4b)6b. Ascomata with clear hymenium, without orange globules 7

(6b)7a. Pseudostromata brownish black to black, immersed; ascospores fusiform, 33-53 µm in size .... *L. fusispora*

(6b)7b. Pseudostromata concolorous with the thallus; ascospores never fusiform, more than 60 µm 8

(7b)8a. Ascomata immersed; periostiolar region black, disc like, separated from the tissue of pseudostromata by deep cleavage; ascospores 66-

100 x 16.5-28 µm; cortex K + red .... L. varia

(7b)8b. Ascomata semi-emergent; periostiolar region brownish black not separated by cleavage; ostioles papillate; ascospores 95-160 x 30-50 µm in size; cortex K + orange .... L. indica

(2b)9a. Pseudostromata white, polycarpic; ascospores 2/ascus, 99-132 x 26.4-36.30 µm in size .... L. sphaerioides

(2b)9b. Pseudostromata other than white; ascospores 2-4/ascus 10

(9b)10a. Pseudostromata concolorous with the thallus; ascospores 2/ascus, 99-118 x 30-37 µm in size; thallus farinaceous, cracked .... L. subsphaerioides

(9b)10b. Pseudostromata concolorous or brown; ascospores 2-4/ascus, 100-178 x 33-43 µm; thallus not farinaceous, smooth .... L. vezdae

(1b)11a. Tissue of the pseudostromata totally carbonized; type L. phaeomelodes 12

(1b)11b. Tissue of the pseudostromata not carbonized 14

(11a)12a. Pseudostromata monocarpic ..... L. subdiscreta

(11a)12b. Pseudostromata polycarpic 13

(12b)13a. Pseudostromata 1-5 carpic; ascomata surrounded by scale like structure at the base; ascospores oblong, 23-46 x 7-13 µm in size .... L. phaeomelodes

(12b)13b. Pseudostromata 1-polycarpic (large number); ascomata not surrounded by scale like structure, glossy; ascospores 34-46 x 12-15 µm in size .... L. verrucoaggregata

(11b)14a. Outer most zone of the pseudostromata consisting of brown hyphae followed by medullary zone and the inner most zone of light brown hyphae; type L. madreporiformis 15

(11b)14b. Outer most zone of the pseudostromata is brown, K + red, followed by zone of Ca-oxalate crystals and internal amorphous zone; type L. cumingii 16

(14a)15a. Ascomata strongly columellate; pseudostromata white; ascospores 85-169 x 30-33 µm in size .... L. alboverruca

(14a)15b. Ascomata ecolumellate; pseudostromata brownish black to black; ascospores 70-132 x 40-50 µm in size .... L. tuberculosa

(14b)16a. Pseudostromata orange, medulla yellowish orange, ascospores 36-66 x 10-12 µm in size .... L. cumingii

(14b)16b. Pseudostromata greenish yellow to yellow; ascospores 60-76 x 13-19 µm in size .... L. benguelensis

1. Laurera alboverruca sp. nov. (Figs : 7, 11, 28)

Typus : Andaman Islands, South Andaman, Port Mout, 14.2.1985, P.G. PATWARDHAN, M.B. NAGARKAR & P.K. SETHY, 85.36 (Holotype-AMH, Isotype-BM).

Thallus olivaceus, endophloeodes; stratum corticale amorphum, 26-43 µm crassum; stratum gonidiale 16.5-33 µm crassum; stratum medullare albidum; pseudostromata thallo fere concolores vel albida, prominentes, oligocarpica, 1-3 ascomata continentes, circa 1-2 mm lata, ostiolo fusco vel nigro periostiolo nigro; structura pseudostroma ejusdem modi ac groupe L. madreporiformis, columella centrali basi dilatata, apice acuto instructa, ascosporae 6-8 nae, oblongae, medio constrictae, parenchymaticae, 85-169 µm longae at 30-33 µm latae.

Thallus corticolous, crustose, grayish-green to olive green, endophloeodal; cortex 26-43 µm thick; ascomata strongly erumpent, 1-2 mm in diameter, columellate, embedded in monocarpic to tri-carpic pseudostromata; ostioles black, centrally situated, surrounded by black annular rim, wide open; structure of the pseudostroma differentiated into three different zones as in L. madreporiformis; ascospores 6-8/ascus, oblong, parenchymatous, constricted at the middle, transversely and vertically multiseptate, 85-169 x 23-33 µm in size.

Chemistry : Thallus K-, P-. Medulla of the pseudostroma K-, P-.

Specimen Examined : South Andaman, Port Mout, 85.38.

Remarks : L. linearis (Dodge) Letr. G. and L. sphaerica (Dodge) Letr. G., the only two species of the group L. madreporiformis (Letrouit-Galinou, 1957) having large ascospores (more than 100 µm in length), are comparable with L. alboverruca which, however, has white mono-tricarpic, highly elevated pseudostromata, medulla K-, strongly columellate ascomata and much larger ascospores (85-169 µm long) with middle septum distinctly thickened and constricted.

2. Laurera aurantiaca sp. nov. (Figs : 12, 29)

Typus : Karnataka, Agumbe - Shringeri Road, 28.2.77, P.G. PATWARDHAN & M.B. NAGARKAR, 77.461 (Holotype-AMH).

Thallus sordide glaucescens, subolivaceus vel olivaceus, verrucosus, hypothallo nigricante limitatus; stratum corticale 23-66 µm crassum; stratum medullare albidum, ascomata nigra, hemisphaerica, immersa in pseudostroma ostiolo nigro, punctato, papillato; periostiola punctata vel complanata; pseudostromata thallo fere concolores, elevata, globosa, 1-5 carpica, circa 1-3.5 mm longa et 1-3 mm lata;structura pseudostroma, ejusdem modi ac groupe L. megasperma, gelatina hymenialis sed numerosas guttulas aurantiacas continens; ascosporae octonae, naeviculatae, extremitatibus obtusis vel leviter attenuatis, 116-135 µm longae et 26-33 µm latae, septis transeversis multi, septis verticalibus 1-6, medio constrictae.

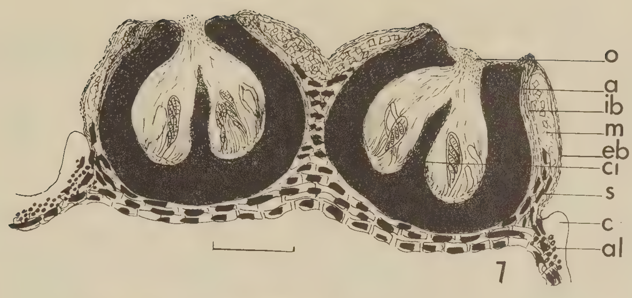
Thallus corticolous, crustose, grayish green to olivaceous green, distinctly warty; warts rounded to vertically elongated, determinated by black hypothalloidal region at the periphery; cortex 23-66 µm thick, hyaline; medulla white; ascomata black, carbonized, hemisphaerical, thin at the base; ostioles black, punctate, centrally situated, surrounded by black periostiolar region; pseudostromata concolorous with the thallus, rounded to orbicular, elevated, 1-5 carpic, 1-3.5 mm long and 1-3 mm broad, structure of the pseudostroma of the L. megasperma type, hymenium hyaline but completely saturated with orange coloured globules, ascospores 8/ascus, often constricted at the middle, transversely many septate, vertically 1-6 septate, 115.5-135 x 26-33 µm in size.

Chemistry : Thallus K + Yellow. Medulla of the pseudostroma K-, P-.

Remarks : L. aurantiaca holds an isolated position among the species of the group L. megasperma by the unusual presence of orange coloured globules in the hymenial tissue. Perhaps in this respect it is nearest to L. santessoni Letr. G. which has the hymenium saturated with a red coloured substance. L. santessoni is, in fact, not comparable with the present species in regard to other characters.

Another species, L. sanguinaria Malme, also contains a red coloured substance, but only in the medullary region of the pseudostroma and not in the hymenial tissue.

Figs 7-10 : Structure of the pseudostromata 7.L. alboverruca (85.36, Holotype-AMH); 8. L. columellata (78.59, Holotype-AMH); 9.L. indica (85.656, Holotype-AMH); 10. L. sikkimensis (77.1970, Holotype-AMH). Explanation for the abbreviations used in figures. a, ascoma; al, algal layer; b, supplementary brown layer; c, an amorphous cortical zone; cl, columella; eb, external zone of brown hyphae; hl, hyaline supplementary layer resembling medullary zone; ib, inner zone of brown hyphae; ic, inner amorphous zone; m. medullary zone (crystals studded); s, substratum cells; w, vertical walls of ascoma. Scale = 500 µm.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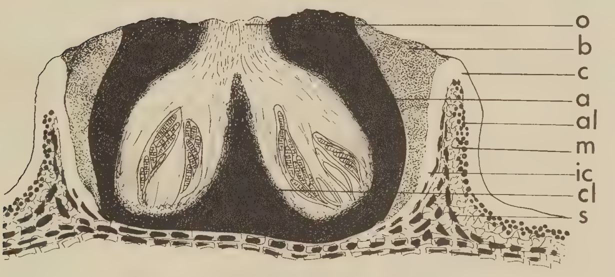
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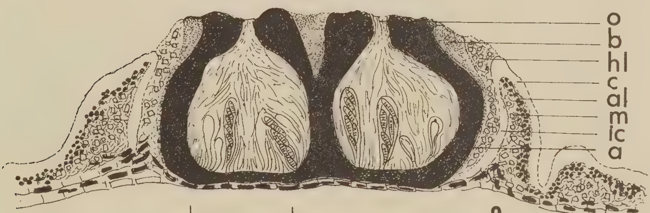
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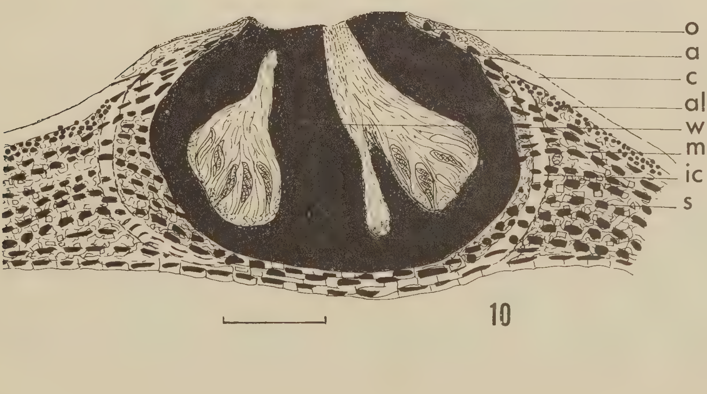
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3. Laurera benguelensis (Müll. Arg.) A. Zahlbr. in Cat Lich. Univ., 1 : 503, 1922. Bathelium benguelense Müll. Arg. in Flora, 68 : 256, 1885. (Figs : 13, 30)

Type : Bengal, leg. S. KURZ, 1883, n. 852, Ex Herb. Mull. Arg. G. (designated by Letrouit-Galinou, 1957).

Thallus corticolous, crustose, yellow, smooth, cracked; cortex 50-70 µm thick, light green to hyaline; medulla white, studded with crystals; ascomata black, carbonized, embedded in greenish yellow to yellow, highly elevated pseudostromata; pseudostromata 2.5-5 mm long and 1-1.5 mm broad, with flattened tops, covered with yellow coloured pruina, consist of 1-6(10) ascomata; structure of the pseudostromata of the L. cumingii group, but here without a particular zone containing Ca-oxalate crystals exclusively. These crystals are mixed in the external, orange-brown coloured layer, forming a pruina on the thallus. A secondary cortex becomes organised from the superficial hyphae of the external zone of the pseudostroma, ascospores 8/ascus, ovate-oblong, ends obtuse, transversely 15-20 septate, vertically 1-5 septate, 60-76 x 13-19 µm in size.

Chemistry : Thallus K-, P-. Medulla of the pseudostroma K-, P-. Pruina (forming the outer layer of pseudostroma) K + red, P-.

Specimens Examined : Karnataka, near Mangalore, Manjeshwar, 76.1012, 76.1015, 76.1016; Bengal, S. KURZ no. 2o2, H.Nyl. No. 122, S. KURZ, sn, H.Nyl. No. 125, S. KURZ. no. 173, H. Nyl. No. 128, 173 (H).

Remarks : L. benguelensis can easily be distinguished from the allied L. cumingii (Mont.) A. Zahlbr., especially by its greenish yellow to yellow pseudostromata covered by yellow pruina. L. cumingii, however, is characterised by bright orange coloured pseudostromata having a distinct zone containing Ca-oxalate crystals but in L. benguelensis there is no comparable zone of Ca-oxalate crystals and these are mixed in the external orange-brown coloured layer which resembles pruina frequently covering the thallus.

This species was previously known only from Bengal (type locality), India.

4. Laurera columellata sp. nov. (Figs : 8, 14, 31).

Typus : Karnataka, S. Kanara, Hiriyadaka, Udupi-Hebri Road, in moist rain forest, elevation 150 ft., 22.2.1978, P.G. PATWARDHAN, 78.59 (Holotype-AMH, Isotype-BM).

Thallus viridis, olivaceus-viridis, vel flavo-viridis, laevigatus vel verrucosus, limitatus; stratum corticale 16.5-66 µm crassum; stratum medullare albidum, ascomata subglobosa vel globosa, columello centrali basi dilatato, immersa in pseudostroma, ostiolo punctato, nigro, periostiolo complanato, nigro; pseudostromata thallo concolores, valde elevata, prominentes, maximum partem monocarpica, raro bi-tricarpica, constricta, rotundata, circa 0.8-2.5 mm diametro; structura pseudostroma ejusdem modi ac groupe L. megasperma; ascosporae octonae, rectae vel curvulae, 160-200 µm longae et 23-33 µm latae, medio constrictae.

Thallus corticolous, crustose, green, olivaceous green to yellowish green, smooth to distinctly verrucose, determinate; cortex 16.5-66 µm thick, hyaline; medulla white, crystals studded, ascomata black, carbonized, globose to subglobose, embedded in strongly elevated pseudostromata, invaribly columellate, ostioles black, punctate, centrally oriented, surrounded by black periostiolar region often covered with tissue of the pseudostroma, pseudostromata, concolorous with the thallus, highly elevated, constricted at the base, with white, flattened tops, mostly monocarpic, rarely 2-3 carpic, structure of the pseudostroma of the L. megasperma type, but a supplementary brown coloured, woody layer present between the inner amorphous zone and the wall of the ascomata, ascospores 8/ascus, with ends obtuse to slightly acute, straight to slightly curved, constricted at the middle, transversely and vertically many septate, 160-200 x 23-33 µm in size.

Chemistry : Thallus K + Yellow, P-. Medulla of the pseudostroma K-, P-.

Specimens Examined : Karnataka, Sringeri, 2 km from Sringeri, Sringeri - Balehonur Rd -74.3129, 74.3130, 74.3131, 74.3134, 74.3135, 74.3147, 74.3209; 6 km from Sringeri, on the Sringeri - Balehonur Road - 74.3173, 74.3229, 74,3259, 31 km from Sringeri - Balehonur Road - 74.3161, 74.3162, Bettigeri - 74.3412; Agumbe - Sringeri Road, 77.448; Sirsi - Siddhapur Road, -77.184; Hiriyadaka, Udupi - Hebri Road, moist rain forest approx. 150 ft. elev. -78.32, 78.36, 78.37, 78.54, 78.55, 78.56, 78.57, 78.58; Mercara - Bagmandala - 74.3413; Kerala, Anamalai hills, Vazachal, 76.361, Maryoor -76.448; Andaman Islands, North Andaman, Diglipur Range, Moist forest Sitapur - 86.76, 86.77, 86.79; Tugapur Range, Pathar Thikri - 85.2424.

Remarks : This new species is well characterized by the highly elevated, large, rounded, mostly monocarpic, constricted pseudostromata concolorous with the thallus and with white flattened tops; invariably with strongly columellate ascomata and ascospores 8/ascus, constricted at the middle septum, 160-200 x 23-33 µm in size.

L. columellata seems to be very closely related to L. megasperma (Mont.) Riddle and L. meristospora (Mont.) A. Zahlbr. and in many respects it seems to be intermediate between these two species.

It agrees well with the L. megasperma in regard to the structure of the pseudostromata but the ascospores are much larger (200-330 µm in length), 4/ascus in L. megasperma.

L. columellata resembles to L. meristospora in having mostly monocarpic, elevated, concolorous pseudostromata and in having similar type of ascospore morphology and size. However, the structure of the pseudostroma is different from L. meristospora in having a supplementary brown woody layer between the inner amorphous zone and the wall of the ascomata. In addition, the ascomata of L. columellata are always columellate.

5. Laurera cumingii (Mont.) Zahlbr., in Cat. Lich. Univ. 2 : 503, 1922. Trypethelium cumingii Mont., in Hook, London

J. Bot. 4 : 5, 1845. (Figs : 5, 15, 32)

Type : Philippines, CUMING, 2170, P., BM (!) (designated by Letrouit-Galinou, 1957).

Thallus corticolous, crustose, pale greenish brown to yellowish brown, smooth; cortex 16.5-66 µm thick, often studded with hyaline crystals; algal layer 13-40 µm thick; medulla orange-yellow, studded with hyaline crystals; ascomata 1-20 aggregated, yellowish orange to orange, hemispherical, 0.4-1.0 mm in diameter, with black tops, the structure of the pseudostroma of the L. cumingii type, ascospores 8/ascus, parenchymatous, ovate, oblong, ends obtuse, 36.33-66 x 10-22 µm in size.

Chemistry : Thallus K + red, P-. Medulla of the pseudostroma K + red.

Specimens Examined : North Andaman, Pathar Thikri, Tugapur Range, 85.2402; Middle Andaman, Betapur Range, Pitcher Nala, 85.2387; Dhaninala, 85.2481; South Andaman, Little Andaman, South Bay, 85.1019. Philippines, CUMING 2169, BM.

Remarks : The species is reported for the first time from India.

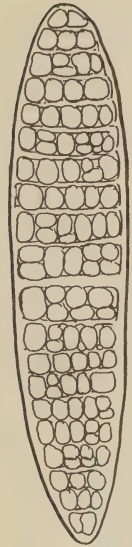
6. Laurera fusispora sp. nov. (Figs : 16, 33)

Typus : Karnataka, Anamod ghat, 5 km from Anamod check post, Anamod-Goa Road, 10.12.1974, P.G. PATWARDHAN and A.V. PRABHU, 74.2499 (Holotype-AMH, Isotype-BM).

Thallus subviride-flavescens, verrucosus, rimosus, hypothallo nigricante limitatus; stratum corticale 30-60 µm crassum; stratum medullare album; pseudostromata fusco-nigra vel nigra, polycarpica, immersa, irregulares; structura pseudostroma ejusdem modi ac groupe L. megasperma; ascosporae octonae, fusiformae, extremitatibus, acutis, 33-53 µm longae et 8-10 µm latae, septis transversis 10-15, septis verticalibus 1-3.

Thallus corticolous, crustose, greenish yellow, distinctly verrucose, cracked, determinate; cortex 30-60 µm thick; medulla white, studded with crystals; ascomata black, carbonized, sphaerical, externally not visible, totally embedded in pseudostromata; ostioles black, punctate, often indistinct; pseudostromata blackish brown to totally black, large, irregularly spread all over the thallus, immersed between thalline warts, polycarpic; structure of the pseudostroma of the L. megasperma type, a supplementary brown tissue observed between the internal amorphous zone and the wall of the ascomata towards the ostiolar region;

Figs 11-18 : Ascospores. 11. L. alboverruca (85.36, Holotype-AMH); 12. L. aurantiaca (77.461, Holotype-AMH); 13. L. benguelensis (76.1015); 14. L. columellata (78.59, Holotype-AMH); 15. L. cumingii (85.1019); 16. L. fusispora (74.2499, Holotype-AMH); 17. L. indica (85.656, Holotype-AMH); 18. L. megasperma (73.2325).



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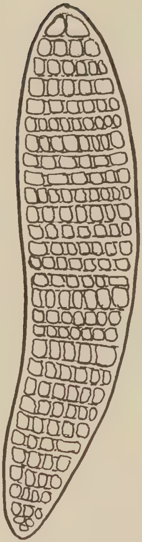

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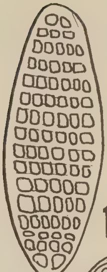

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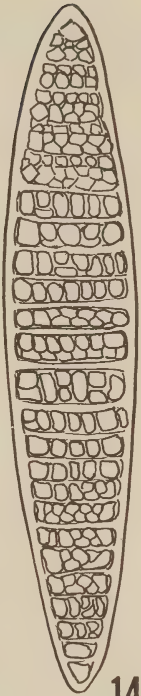

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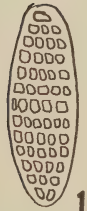

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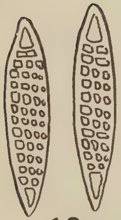

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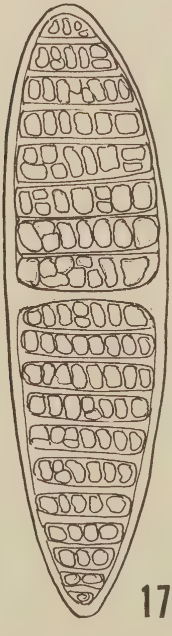

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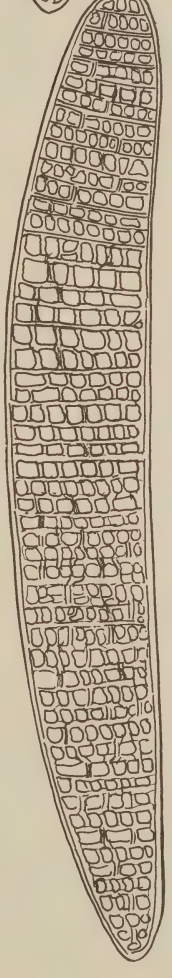

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ascospores 8/ascus, hyaline, muriform, fusiform, ends acute, transversely 10-15 septate, vertically 1-3 septate, 33-53 x 8-10 µm in size.

Chemistry : Thallus and medulla of the pseudostroma K-, P-.

Specimens Examined : Karnataka, Anamod Ghat, 1 km from Anamod check post, Anamod-Goa Road, 74.2477; Devimane Ghat, Sirsi Kumtha Road, 74.2607, 74.2608.

Remarks : The thin fusiform ascospores characteristic of the present species are rather rare among *Laurera* species. This type of ascospore is found in *L. pyriformis* (Dodge) Letr. G.

The new species, with the structure of the pseudostroma of the *L. megasperma* group type, is distinct from all other species of *Laurera* by its highly verrucose thallus; large, blackish brown to black irregularly spreading, polycarpic, flattened, immersed pseudostromata and thin, fusiform ascospores.

7. *Laurera indica* sp. nov. (Figs : 9, 17, 34).

Typus : Andaman Islands, South Andaman, Baratang Islands, Bishnu Nala, 22.2.1985, P.G. PATWARDHAN and P.K. SETHY - 85.656 (Holotype-AMH, Isotype-BM).

Thallus sordid glaucescens vel flavoalbus continuus inaequalis; stratum corticale 16.5-33 µm crassum; stratum medullare albidum; ascomata integra, nigra, subsphaerica, ostiolo punctato, nigro; periostolum nigrum; pseudostromata thallo fere concolores, prominentes, oligocarpica, 1-8 ascomata contentes, rotundata, elongata, circa. 0.5-5 mm diam; parum evoluta vel evoluta; structura pseudostroma ejusdem modi ac *L. megasperma*; ascosporae octanae, extremitatibus obtusis, vel leviter attenuatis, 95-160 µm longae et 30-50 µm latae, septis transversis multi, septis verticalibus 1-8, medio constrictis.

Thallus corticolous, crustose, glaucous to yellowish white, more or less uneven; cortex hyaline, 16.5-33 µm in elevated pseudostromata; ostioles black, punctate, centrally situated, surrounded by black periostiolar region; pseudostromata concolorous with the thallus, 1-8 carpic, ± rounded, 0.5-5 mm in diameter; structure of the pseudostroma of the *L. megasperma* group, ascospores 6-8/ascus, transversely many septate, vertically 1-8 septate, 95-160 x 30-50 µm in size.

Chemistry : Thallus K + orange. Medulla of the pseudostroma K-, P-.

Remarks : *L. indica* holds an isolated position in having pseudostromata with two supplementary layers between the inner amorphous zone and the ascoma wall. The one towards the inner amorphous zone is more or less medulla like and is saturated with numerous hyaline crystals and the second one, lining the wall of ascoma, is brownish red in colour and very thick towards the ostiolar region.

8. Laurera megasperma (Mont.). Riddle, in Bull. Torrey Bot. Club, **44** : 323, 1917. Trypethelium megaspermum Mont. in Ann. Sci. Nat. Bot., ser. 2, 19 : 68, 1843. Zahlbruckener, A., 1922, Cat. Lich. Univ., 1 : 505. (Figs : 2, 18, 35).

Type : Guyana, Francaise, leg. LEPRIEUR - P (designated by Letrouit-Galinou, 1957).

Thallus corticolous, crustose, whitish green, yellowish green or greenish brown, uneven but not distinctly verrucose, determinate by thick black hypothalloidal region at the periphery; cortex 20-40 µm thick, hyaline; medulla white, studded with crystals; ascomata black, carbonized, more or less sphaerial with black, punctate, centrally oriented ostioles surrounded by white rim which is formed by the exposed white medulla of pseudostroma, embedded in pseudostromata; pseudostromata concolorous with the thallus, elevated, 1-3-carpic, rarely 4-carpic, 1-4 mm long and 1-2.5 mm broad; structure of the pseudostroma of the L. megasperma type, ascospores 4-6/ascus, cylindrical with obtuse ends, transversely and vertically many septate, 230-298 x 26-36 µm in size.

Chemistry : Thallus and Medulla of the pseudostroma K-, P-.

Specimens Examined : Kerala, cardamom hills, Kumali Road, 73.2325, 73.2329, 73.2351, Darugiri, Darugiri reserved forest, Baghmara Road, 10 km from Ronjengh, 78.410; Ceylon, South of the Island, G.H.K. THAWAITES-BM; Amazonia, C. WRIGHT, verr. Cub. 184-BM; Brazil, DR. BURCHELR. n. 339b-BM.

Remarks : Laurera megasperma (Mont.) Riddle is very well distinguished from all known species of Laurera by its very large (200-300 (330) µm long), mostly 4/ascus ascospores.

This species is reported for the first time from India.

9. Laurera phaeomelodes (Müll. Arg.) A. Zahlbr. in Engler-Prantl, Natürl. Pfhlanzenfamil., I Teil, Abt. **1** : 71, 1903. Bathelium phaeomelodes Müll. Arg. in Engler, Bot. Jahrbuch **6** : 394, 1885. Zahlbruckner, A., Cat. Lich. Univ. 1 : 506, 1922. (Figs : 19, 36)

Type : Cuba, leg. WRIGHT, 1883, n. 170 - Herb. Müller - G. (designated by Letrouit-Galinou, 1957), Isolectotype-H(!).

Thallus corticolous, crustose, smooth, olivaceous brown, determinate by a black hypothalloidal region at the periphery, completely endophloeodal; cortex 20-66 µm thick; algal layer 13-33, µm thick, ascomata black, carbonized, hemispherical, 0.4-0.6 mm in diameter, 1-5 aggregated i black, irregularly shaped pseudostromata, united at the level of the thalline region and appearing like scales, ostioles black, punctate, ascospores 8/ascus, ovate t oblong, 23-46 x 7-13 µm in size.

Chemistry : Thallus K-, P-. Medulla of the pseudostrom K-, P-.

Specimen Examined : Little Andaman, South Bay, 85.1015.

Remarks : L. phaeomelodes, earlier known from Cuba, is reported for the first time from India.

10. Laurera sikkimensis sp. nov. (Figs : 10, 20, 37)

Typus : Sikkim, Gangtok, Near Tangshi View Point, 17.11.77, P.G. PATWARDHAN and M.B. NAGARKAR, 77.1970 (Holotype-AMH, Isotype-BM).

Thallus crassus, continuus, verrucosus, olivaceus vel fuscus, stratum corticale circa 66-100 µm crassum; stratum medullare album; pseudostromata thallo fere concolores, oligocarpica, 1-5 ascomata continentes, circa 1-5 mm longa et 1-6.5 mm lata; ascomata multiloculata, periostiola nigra, albida annulata, ostiolo nigro; structura pseudostroma ejusdem modi ac groupe L. megasperma, scilicet verrucae hyphis intermixtis cum cellulis substrati; ascosporae octonae, murales, hyalinae, extremitatibus obtusis vel attenuatis, 60-150 µm longae et 23-26 µm latae, septis transversis 10-18, septis verticalibus 1-5.

Thallus corticolous, crustose, dark greenish brown to brown, verrucose, determinate by black hypothalloidal region at the periphery; cortex 66-100 um thick; medulla white; ascomata large, woody, black carbonized, embedded in large pseudostromata, hymenium divided into more than one chambers by thick, carbonized walls, ostioles black, punctate, centrally oriented, surrounded by black periostiolar region with white annular rim; pseudostromata slightly to highly elevated, concolorous with the thallus, horizontally elongated, 1-5 carpic, 1-7 mm long and 1-6.5 mm broad; structure of the pseudostroma of the L. megasperma type, but most of the part covered with the bark cells up to the ostiolar region, ascospores 8/ascus, transversely 10-18 septate, vertically 1-5 septate, 66-150 x 23-26 µm in size.

Chemistry : Thallus K + yellow, P-. Medulla of the pseudostroma K-, P-.

Remarks : The present new species is very well distinguished from the allied species of the L. megasperma group by its dark brown, verrucose thallus, concolorous pseudostromata with columellate or multioculate ascomata and smaller ascospores of the size 66-150 x 23-26 µm with a constriction at the middle septum. In addition, most tissue of the pseudostroma is covered with bark cells.

On account of the ascospore size and morphology it can be compared with the L. chrysocarpa (Müll. Arg.) A. Zahlbr. which, however, has different morphology of the pseudostroma

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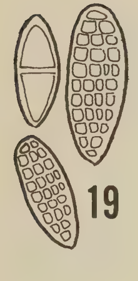
Figs 19-27 : Ascospores. 19. L. phaeomelodes (85.1015); 20. L. sikkimensis (77.1970, Holotype-AMH); 21. L. sphaerioides (85.869); 22. L. subdiscreta (H.Nyl. No. 322, Lectotype-H); 23. L. subsphaerioides (85.168, Holotype-AMH); 24. L. tuberculosa (74.2689, Holotype-AMH); 25. L. varia (85.1096); 26. L. verrucoaggregata (86.550, Holotype-AMH); 27. L. vezdae (74.2183, Holotype-AMH).



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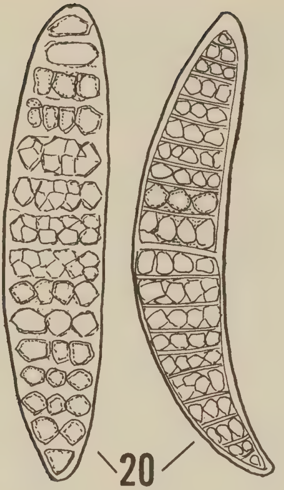

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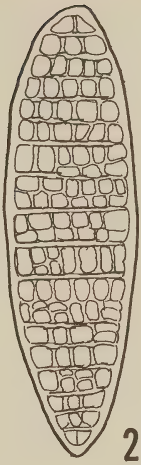

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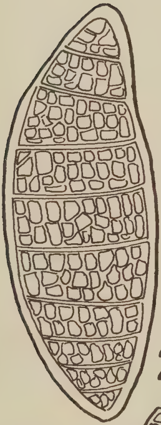
50 µm



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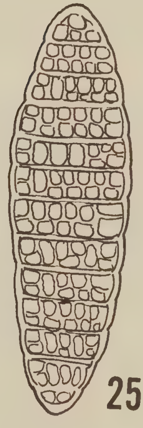

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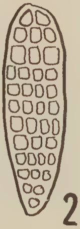

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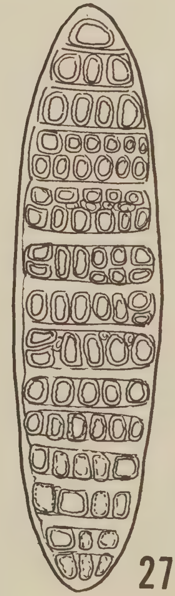

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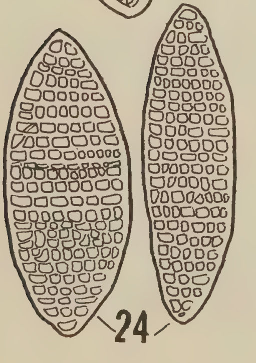

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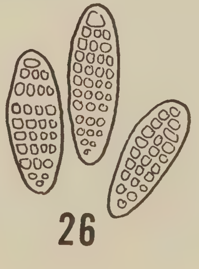

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intermediate between the *L. megasperma* and *L. madreporiformis* types.

11. *Laurera sphaerioides* (Mont.) A. Zahlbr. in Cat. Lich. Univ. 1 : 506, 1922. *Trypethelium sphaerioides* Mont. in Ann. Sci. Nat. Bot., Ser. 2 19 : 73,1843. (Figs : 3, 21, 38)

Type : Guyana, LEPERIEUR, 80, syntype-BM (!).

Thallus corticolous, crustose, brown, smooth, totally endophloeodal; algal layer deeply situated in the thallus; ascomata aggregated in white slightly elevated, monocarpic to polycarpic (2-13), 1-9 mm long and 2-3 mm broad, rounded, linear or irregular, white pseudostromata, black, carbonized emergent; ostioles black, punctate to wide open, ascospores 2/ascus, ovate, parenchymatous, 99-132 x 26.4-36.30 µm in size.

Chemistry : Thallus K-, P-. Medulla of the pseudostroma K-, P-.

Specimens Examined : South Andaman, Baratang, Nilambur, Forest Guest house, 85.348, 85.869.

12. *Laurera subdiscreta* (Nyl.) A. Zahlbr. in Cat. Lich. Univ. 1 : 506, 1922. *Trypethelium subdiscretum* Nyl. in Flora, 52 : 73, 1869. (Fig : 22)

Type : Bengal, S. KURZ. H. Nyl. No. 322-Lectotype-H (!).

Thallus corticolous, crustose, completely endophoeodal, olivaceous green to brown; cortex yellow, totally endophloedal; ascomata black, carbonized, subglobose; ostioles black, punctate, centrally situated, not very distinct; pseudostromata blackish green, more or less rounded, 0.5-0.8 mm in diameter, monocarpic; structure of the pseudostromata of *L. phaeomelodes* type, ascospores 8/ascus, hyaline, ellipsoidal, 29.7-50 x 9.9-19.8 µm in size.

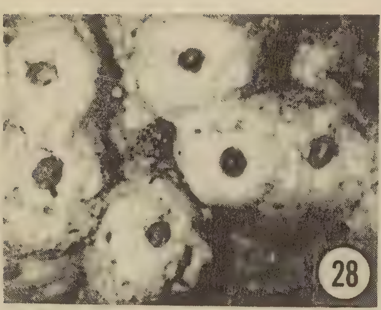
Chemistry : Thallus and medulla of the pseudostroma K-, P-.

Remarks : *L. subdiscreta* (Nyl.) A. Zahlbr. is characterised by the small, greenish black, monocarpic pseudostromata which distinguish the species from the other known species of the group *L. phaeomelodes*, namely *L. phaeomelodes* (Müll. Arg.) A. Zahlbr. and *L. dodgei* Letr. G. In addition *L. dodgei* has very large ascospores (120-150 x 28-40 µm).

13. *Laurera subsphaerioides* sp. nov. (Figs : 23, 39)

Typus : Andaman Islands, South Andaman, Wimberliganj,

Figs : 28-35 : 28. *L. alboverruca* (85.36, Holotype-AMH); 29. *L. aurantiaca* (77.461, Holotype-AMH); 30. *L. benguelensis* (76.1015); 31. *L. columellata* (78.59, Holotype-AMH); 32. *L. cumingii* (85.1019); 33. *L. fusispora* (74.2499, Holotype-AMH); 34. *L. indica* (85.656, Holotype-AMH); 35. *L. megasperma* (73.2325, Holotype-AMH). Scale in mm.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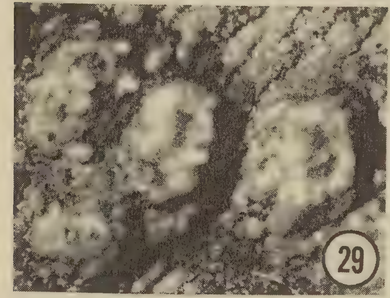
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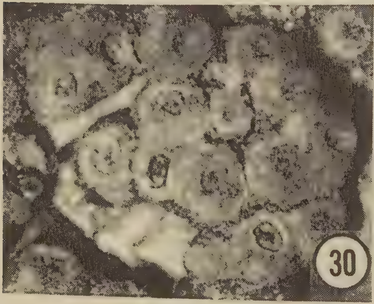
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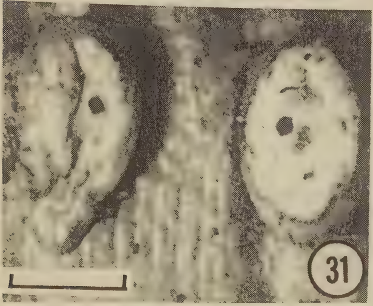
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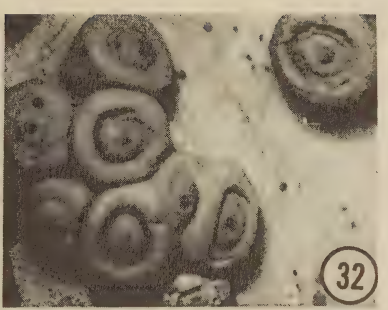
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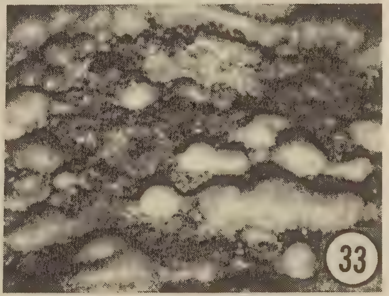
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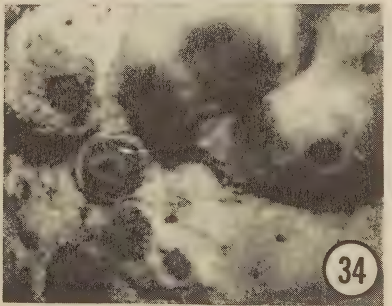
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Kalatang, 16.2.1985, P.G. PATWARDHAN, M.B. NAGARKAR and P.K. SETHY, 85.168 (Holotype-AMH, Isotype-BM).

Thallus crustaceus, fuscus, tenuis, farinaceus laevis, ramosus, endophloeodes; stratum gonidiale penitum; pseudostromata thallo concolores, 1-oligocarpica, 1-2.5 mm diametro; ostiola nigra, punctiformia, structura pseudostroma ejusdem modi ac groupe *L. sphaerioides*, ascosporae binae, 1-seriales, hyalinae, oblongato-ellipsoideae, parenchymaticae, 99-118 µm longae et 30-37 µm latae.

Thallus corticolous, crustose, distinctly cracked, brown, totally endophloeodal, farinaceous; algal layer deeply situated in the thallus; ascomata 1-5, embedded in concolorous, 1-2.5 mm in diameter thalline verrucae, externally visible by their black, punctate, centrally situated ostioles; the structure of the pseudostroma of the *L. sphaerioides* group, ascospores 2/ascus, ovate, oblong, ellipsoidal, parenchymatous, 99-118.80 x 30-37 µm in size.

Chemistry : Thallus K-, P-. Medulla of the pseudostroma K-, P-.

Specimen Examined : South Andaman, Wimberlinganj, Kalatang 85.171.

Remarks : Only two species of the group *L. sphaerioides* (Letrouit Galinou, 1957) - *L. sphaerioides* (Mont.) A. Zahlbr. and *L. chrysoglypha* (Vainio) A. Zahlbr. have two spored asci. Both of these species, however, have much larger, polycarpic pseudostromata. *L. sphaerioides* has 1 cm long, white pseudostromata with a white, medulla (K-), while *L. chrysoglypha* has large (2-15 x 1.5-3 mm), polycarpic (up to 25 ascomata) pseudostromata with orange medulla (K + red).

The present new species, thus, can be distinguished from *L. chrysoglypha* and *L. sphaerioides* in having a distinctly farinaceous and cracked thallus, concolorous pseudostromata with only 1-5 ascomata and a white medulla (K-).

14. *Laurera tuberculosa* sp. nov. (Figs : 6, 24, 40)

Typus : Karnataka, Sirsi-Kumtha Road, 48 km from Sirsi, 12.12.1974, C.R. KULKARNI, 74.2689 (Holotype-AMH, Isotype-BM).

Thallus epiphloeodes, ochraceo-olivaceus, tuberculosoverrucosus; stratum corticale 30-100 µm crassum; stratum medullare album; ascomata fusco-nigra, ovoidia, basi tenuiora, ostiolo punctato, papillato nigro, periostolo fusco-nigro; pseudostromata fusco-nigra vel nigra, monocarpica, raro 2-3 carpica, sphaerica, basi-constrictica, circa 1-1.5 (-2) mm diametro; structura pseudostroma ejusdem modi ac groupe *L. madreporiformis*; stratum medullare des pseudostromata saturatum sanguineum; ascosporae 4-8:nae, hyalinae, ellipsoideo-ovate, murales, parenchymaticae, 70-132 µm longae et 40-50 µm latae.

Thallus corticolous, crustose, yellowish green to yellowish olivaceous, distinctly verrucose, verruceae globose to tuberculoid, sometimes completely separating from the main thallus; cortex 30-100 µm thick; medulla white, studded with crystals; ascomata blackish brown, completely embedded in pseudostromata ovoid, thinly carbonized at the base; pseudostromata, blackish brown to brown, sphaerical, constricted at the base, mostly monocarpic, rarely 2-3 carpic, about 1-1.5(2) mm in diameter, structure of the pseudostroma of the L. madreporiformis group; ascospores 4-8/ascus, hyaline, ellipsoidal, elliptical or ovate, parenchymatous, 70-132 x 40-50 µm in size.

Chemistry : Thallus K-, P-. Medulla of the pseudostroma red, K + purple.

Specimens Examined : Karnataka, Ammanthali, 74.2702, Manipal 77.561.

Remarks : L. tuberculosa, is very well distinguished by its distinctly tuberculoid verrucose thallus and mostly monocarpic to rarely 2-3 carpic, blackish brown pseudostromata with a red coloured substance (K + purple) in the medullary layer.

The presence of a red coloured substance in the medullary layer of the pseudostromata distinguishes it from L. sphaerica (Dodge) Letr. G., which resembles it closely in regard to morphology of the thallus, ascocarps and ascospores.

On account of the red coloured substance the new species comes close to the L. sanguinaria Malme, which has much larger (1-4 mm) polycarpic (often 5-15 carpic) pseudostromata.

L. tuberculosa was found associated with the L. fusispora and it can be mistaken for it if not examined carefully.

15. Laurera varia (Fée emend. Roum. et Müll. Arg.) A. Zahlbr. Engler-Prantl, Natürl. Pflanzenfamil., I. Teil, Abt. I, p. 71, 1903. Meissneria varia Fee in Suppl. Essai Cryptog. Ecorc., Officin., p. 66, tab. XL, fig 1, 1837. Zahlbruckner, A. 1922, Cat. Lich. Univ. 1 : 507. (Figs : 25, 41).

Type : Moluccas, Ambon, LAURIER - Ex. Herb. Müll, Arg., - Lectotype - G (designated by Letrouit-Galinou, 1957).

Thallus corticolous, crustose, yellowish green to olivaceous, cracked, unevenly thickened; cortex yellow, 45-132 µm thick; medulla white, studded with crystals; ascomata black, carbonized completely immersed in pseudostromata and externally visible by their indistinct, black, punctate, centrally situated ostioles surrounded by blackish brown to black disc like periostiolar region, which often separates from the surrounding tissue by a distinct cleavage, pseudostromata concolorous with the thallus, slightly elevated, rounded, orbicular, elongated, 1-7 carpic, 0.5-9 mm long and 0.5-5 mm broad; structure of the pseudostroma of the L. megasperma group, ascospores 8/ascus, straight to curved, ovate, oblong, transversely upto 20 septate, vertically 1-6 septate, 66-100 x 16.5-28 µm in size.

Chemistry : Thallus K + red, P-. Medulla of the pseudostroma K-, P-.

Specimen Examined : Andaman Islands, South Andaman, Alexander Island, 85.1096.

Remarks : L. varia is well distinguished by the pseudostromata 1-7 carpic and concolorous with the thallus, ascomata with externally indistinct ostioles surrounded by rounded to irregular, black coloured, flattened, disc like periostiolar region separating from the surrounding tissue of the pseudostroma by the cleavage and the orange coloured zone of pseudostroma reacting K + red.

The specimen examined, however, varies from the lectotype specimen (Letrouit-Galinou, 1957) of L. varia in having the tissue of the pseudostroma surrounding the ascomata covered by the bark cells except the cortical region up to the ostioles. Thus, the structue apparently reminds one very much of the L. sphaerioides group but, if examined carefully the structure of the pseudostroma is of the L. megasperma group.

The species is reported for the first time from India.

16. Laurera verrucoaggregata sp. nov. (Figs : 4, 26, 42)

Typus : Andaman Islands, North Andaman, on the way to Lamia Bay, in mixed forest, S.E. of Aerial Bay, 5.1.1986, M.B. NAGARKAR and P.K. SETHY, 86.550 (Holotype-AMH, Isotype-BM).

Thallus stramineus, laevigatus, omnino endophloeodes; stratum corticale indistinctcum; stratum medullare albidum. crebre intermixtum in substratum penetrans; ascomata integra, nigra, hemispheaerica vel sphaerica, valde emergentia, nitida, confluentia in pseudostroma, ostiolo punctatato, papillato nigro; pseudostromata prominentes, subnitida et nigra, polycarpica, irregulariter angulosa, varie multiformi elongata et anastomosanta, ascomata in pseudostroma pluriserialae; structura pseudostromata ejusdem modi ac groupe L. phaeomelodis, scilicet pseudostromata hyphis carbonaceis cum cellulis suberosis nigrescentibus substrati immixtis constitutae, ascosporae octonae, murales, hyalinae, ovatae, extremitatibus obtusis vel rotundatis, 34-46 µm longae et 12-15 µm latae, septis transversis 9-11, septis verticalibus 1-4.

Thallus corticolous, crustose, straw coloured, more or less smooth, totally endophloeodal; algal layer deeply situated in the bark cells; medulla white, ascomata black, carbonized, totally emergent, glossy, hemisphaerical to sphaerical, aggregated in black pseudostromata; ostioles black, punctate, centrally situated, papillate; pseudostromata black, carbonized, polycarpic, irregularly spreading over the thallus leaving very little of the vegetative thallus uncovered forming a network on the thallus; structure of the pseudostroma of the L. phaeomelodes group, ascospores 8/ascus, hyaline, transversely 9-11 septate, vertically 1-4 septate, 34-46 x 12-15 µm in size.

Chemistry : Thallus K-, P-. Medulla of the pseudostroma K-, P-.

Specimens Examined : Andaman Islands, North Andaman, Kalipur to Lamia Bay, S.E. of Aerial Bay, 86.535, 86.537, 86.538, 86.594.

Remarks : The present new species, with the structure of pseudostroma of the L. phaeomelodes group, is distinguished by its straw coloured thallus; very large, irregularly shaped, polycarpic, black, irregularly spreading pseudostromata leaving a very little of vegetative thallus uncovered.

It resembles L. phaeomelodes (Müll. Arg.) A. Zahlbr. and L. subdiscreta (Nyl.) A. Zahlbr. in regard to structure of the pseudostroma, ascospore size and morphology. However, L. phaeomelodes is especially distinct in having mono-oligocarpic pseudostromata with a scaly structure at the base, and L. subdiscreta differs in having monocarpic pseudostromata.

17. Laurera vezdae sp. nov. (Figs : 27, 43).

Typus : Maharashtra, Vishalgarh, Amba-Gajapur Road, 6.12.1974, M.B. NAGARKAR and A.V. PRABHU, 74.2183 (Holotype-AMH, Isotype-BM).

Thallus viridi-flavus, nitidus, laevigatus; stratum corticale 33-100 µm crassum; stratum medullare albidum; ascomata integra, nigra, endophloedal, ostiolo punctato, nigro, pseudostromata thallo fere concoleores vel bruneo-flava, 1-15 carpica, rotundata vel irregulara, 1-6.5 mm longa et 1-5.5 mm lata; structura pseudostroma ejusdem modi ac L. sphaerioidis, stratum gonidiale thalli in pseudostroma non penetrans, stratum gonidiale thalli in pseudostroma non penetrans, pseudostroma hyphis cum cellulis substrati immixitis constitutae; ascosporae binae, tetranae, murales, ovatoelongatae, oblongae, extremitatibus obtusis vel rotundatis, 100-178 µm longae et 33-43 µm latae, septis transversis 15-20, septis verticaliibus 1-10.

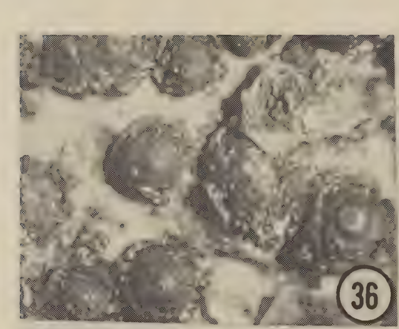
Thallus corticolous, crustose, greenish-yellow, glossy, smooth; cortex 33-100 µm thick, hyaline to very light yellow; medulla white, studded with crystals; ascomata black, carbonized, pyriform, with punctate, internally reddish brown, papillate, black ostioles; pseudostromata concolorous with the thallus or brownish yellow to brown coloured, rounded to irregular, slightly elevated, 1-15 carpic, 1-16.5 mm long and 1-5.5 mm broad; structure of the pseudostroma of the L. sphaerioides type; ascospores 2-4/ascus, transversely 15-20 septate, vertically 1-10 septate, 100-178 x 33-43 µm in size.

Chemistry : Thallus K + orange, P-. Medulla of the pseudostroma K-, P-.

Specimens Examined ,: Maharashtra, Vishalgarh, Amba-Gajapur Road, 74.2175, 74.2180.

Remarks : The present new species is distinguished from the known species of the L. sphaerioides group by its brownish yellow to brown coloured, rounded to irregular elevated pseudostromata, 2-4 spored asci with much larger ascospores reaching 100-178 x 33-43 µm.

The other species of this group, L. sphaerioides (Mont.) A. Zahlbr. has distinctly white, polycarpic,



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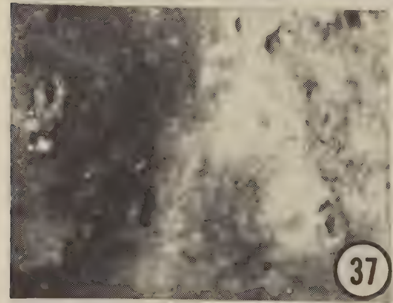

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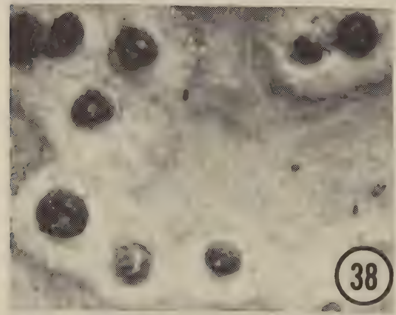

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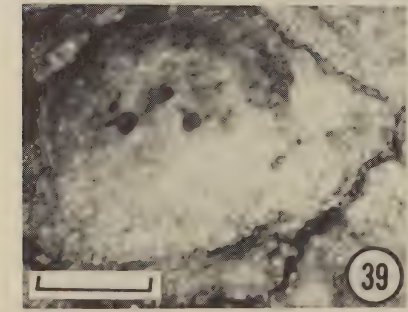

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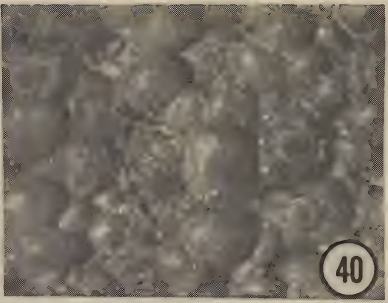

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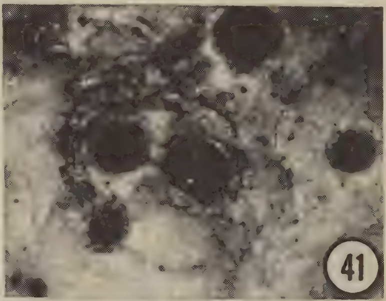

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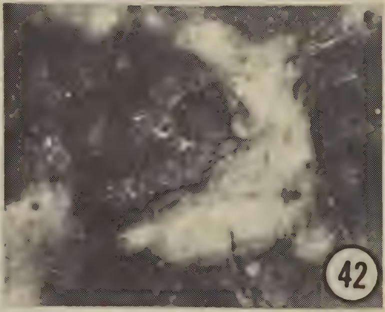

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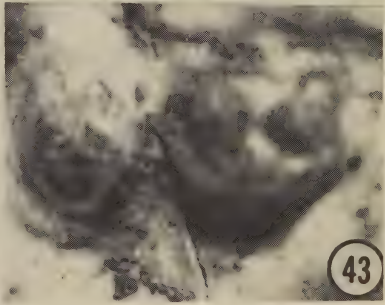

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irregularly shaped pseudostromata and L. chrysoglypha (Vainio) A. Zahlbr. has yellow coloured elevated, polycarpic pseudostromata with orange coloured medulla. Both these species are characterized by 80-150 µm long ascospores and 2-spored asci.

The species has been named after Dr. A. Vezda.

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We are grateful to the Directors/Keepers of the Herbaria of BM, H and TUR for the loan of many specimens, including types, preserved in their herbaria. We are also grateful to Dr. M.E. Hale, Smithsonian Institution, Washington D.C. and to Dr. R.C. Harris, New York Botanical Garden, Bronx, New York, U.S.A. for critical review and valuable suggestions.

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Figs 36-43 : 36. L. phaeomelodes (85.1015); 37. L. sikkimensis (77.1970, Holotype-AMH); 38. L. sphaerioides (85.869); 39. L. subsphaerioides (85.168, Holotype-AMH); 40. L. tuberculosa (74.2689, Holotype-AMH); 41. L. varia (85.1096); 42. L. verrucoaggregata (86.550, Holotype-AMH); 43. L. vezdae (74.2183, Holotype-AMH). Scale in mm.

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MYCOTAXON

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NEOTYPIFICATION OF SPARASSIS CRISPA

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Fungal taxonomy and nomenclature are constantly plagued by the lack of type specimens for purportedly well-known species described by starting point or prestarting point authors. The genus Sparassis Fries is a case in point. According to Burdsall and Miller (1988) it is composed of two species, S. spathulata Schw. and S. crispa Wülf.:Fr. A lectotype was recently designated for S. spathulata by Burdsall and Miller (1988). However, no nomenclatural type exists for S. crispa, the generic-type species. Even though the concept of S. crispa is well understood, it is not possible to relate the presently used biosystematic characteristics of micromorphology, chemotaxonomy, and other taxonomic methods yet to be developed to the words and pictures that now serve as its nomenclatural type. Thus, the purpose of our study was to designate a tangible and appropriate specimen as neotype. This removes the final elements of doubt as to what the name S. crispa represents.

---

[1] Maintained in Madison, WI, in cooperation with the University of Wisconsin.

Elvella ramosa Schaeffer (Schaeffer 1772; p. 106, t. 163; typified by description and illustration) is apparently the earliest name for the taxon called *S. crispa*. Wülfen described it as *Clavaria crispa* Wülf. in Jacquin (Jacquin 1781, p. 100, t. 14, f. 1), and this was the name sanctioned by Fries (1821, p. 465). Unfortunately, there is no known extant material from either of these mycologists. Because Fries (1821) sanctioned the name proposed by Wülfen, a specimen from Carinthia would be the most appropriate to serve as neotype. However, because both Jacquin's and Schaeffer's concepts were included by citation in Fries' work, it is reasonable and allowable to designate a specimen from the locality where Schaeffer collected to serve as a neotype.

Dr. Andreas Bresinsky has made two such specimens available for this purpose. They were collected near Regensburg, Germany, and conform to what we believe was the concept of all three authors and what represents the present concept of *C. crispa*. We have chosen the specimen with the more well-developed radicating base to be neotype.

DESCRIPTION OF NEOTYPE

Sparassis crispa Wülfen: Fr., Syst. Mycol. 1:465. 1821.
 ≡ *Clavaria crispa* Wülfen in Jacquin. Misc. Austriaca 2: p. 100. 1781.
 ≡ *Elvella ramosa* Schaeffer, Fung. Bavaria et Palatinatu. p. 106. 1772.

Neotype: [GERMANY], Etterzhausen, am Fusse von *Pinus silv*., 20.9.76., leg. Besl, Nr. 23 (REG).

Macroscopic Characters: Basidiocarp 6-10 cm broad, 6-10 cm tall, composed of several broad flattened layers of tissue extending from just above ground level and forming broad flabellae that are much dissected and contorted, the ends of the flabellae becoming even more dissected, undulating, and contorted, the apices being 0.5-1 cm wide, abhymenial surface pale creamy yellow, hymenial surface brownish yellow, both surfaces with irregularly oriented veins and ridges; epigeous portion borne on a hypogeus radicating base, composed of soil particles and interwoven hyphae.

Microscopic Characters: Flabellae approximately 1-1.25 mm thick; cutis approximately 20 µm thick with hyphae hyaline, thin-walled, interwoven, 2-4 µm diam, with clamp connections, tips protruding just above the surface; context 800-1,000 µm thick with hyphae extremely variable in shape, (1) hypha-like cells 4-10 µm diam, possessing clamp connections, (2) pseudoparenchymatous cells up to 40 µm diam, both more or less thick-walled; refractive hyphae interspersed among these cells, staining strongly in phloxine and in Melzer's reagent, hyaline, thin-walled, with clamp connections; subhymenium up to 20 µm thick, hyphae densely interwoven, 3-6 µm diam, hyaline, thin-walled, with clamp connections; basidia 50-70 x 5-7 µm, clavate, hyaline, thin-walled, four-sterigmate, with a clamp connection at the base; hyphidia 30-60 x 2-4 µm, apex cylindrical or swollen up to 4 µm diam, hyaline, thin-walled, smooth, clamped at the base; basidiospores broadly ovoid, 5-6(-6.5) x 4-5 µm, hyaline, thin-walled, smooth, not reacting with Melzer's reagent, with a small apiculum.

As indicated by Martin and Gilbertson (1976, p. 637), the fungus called S. radicata in the United States is actually S. crispa. What was known as S. crispa in the southeastern United States is now known to be S. spathulata. Both species cause a brown rot of roots and heartwood of living trees.

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MYCOTAXON

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NOTICE:

ROYAL BOTANIC GARDENS, KEW

Regulations governing loan of mycological specimens

Many requests for the loan of mycological collections are received each year. Processing of these places a heavy burden on the limited staff available for this work and, in addition, postal costs are an increasing strain on the annual budget. All demands for loans therefore cannot be met, and some restriction on the amount of material sent out is necessary.

All requests should be made to the Director by the head of a recognized mycological establishment, who will be expected to accept responsibility for the safe custody and return of the specimens. Loans must not be removed from the establishment to which they are assigned.

Names of the researchers and scope of work should be stated. Loans to postgraduate students will only be sent as the student approaches the final stage of the work.

Loans are normally for three months from receipt, and prompt return is requested. An extension may be granted in exceptional circumstances following a written request.

Full data as to locality, collector and number, author and place of publication is requested. Further, 'Saccardo numbers' are requested where possible for all taxa described prior to 1889, and synonyms or alternative names under which material may be filed are helpful.

Blanket requests for all material of a taxon cannot be met. Loans will normally be limited to 20 specimens. Larger requests will be divided, with the second consignment sent on return of the first. Required specimens should be listed individually.

Requests for types should relate to specimens known to be preserved at Kew. We cannot deal with long lists circulated in duplicate to many herbaria.

Portions of specimens for applied research e.g. biochemistry, electron microscopy, will be supplied only if material is adequate for the purpose. Resulting SEM/TEM photographs are requested in exchange for any material provided.

All microscope slide preparations must be returned. *Determinavit* labels, written legibly in permanent ink and signed, should accompany each returned collection. Any information which might prove of value to future researchers should be provided. Labels must not be glued to the sheet but inserted in the packet.

Reprints resulting from the study of Kew material should be sent to the Kew Library.

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The Co-Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers appearing in this volume:

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		19	for	*Echinopora*	read	*Echinoporia*
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ERRATA, VOLUME THIRTY-ONE

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